1952

Techniques for analyzing farm family level of living and related factors in Iowa

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NOTE TO USERS

TECHNIQUES FOR ANALYZING FARM FAMILY LEVEL OF LIVING AND RELATED FACTORS IN IOWA

by

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A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Rural Sociology

Approved:

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Iowa State College

1952

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I. INTRODUCTION

A. Purpose

Areal variations in levels of living of farm families and the relationship of those variations to social, economic and physical factors have become increasingly a concern of social scientists. Planning of public and private programs, whether social, economic, agricultural or industrial.calls for recognizing the many area differences within a country, within a region, within a state or within whatever geographic unit is under consideration.

Nearly all published level of living studies have been concerned with scalar stratification of families according to some single or multiple criterion. Areal identification and delineation of levels of living and other social phenomena are still in the early stages of development.

The purpose of this study was to try to develop and/or to apply some alternative methods and techniques which would raise the level of understanding of areal differences in levels of living and related factors in Iowa. Corollary to this major objective, answers were sought to the following questions. How do Iowa farm families in different areas of the state differ in their levels of living? The greatest amount of homogeneity with respect to

levels of living exists in what parts of the state? How are levels of living related to crop productivity, corn yield, size of farm, percent of tenancy, farm mechanization, value of land and buildings, population density, population change, percent rural farm population, percent of persons of foreign birth and of mixed parentage and social participation? What is the ecology of the relationships between levels of living and certain of the above factors? What types of areas appear to be best adapted for discriminating variations in levels of living? What is the significance of the relationships and the implications? What are the suggested next steps for research?

Some of the fundamental problems which arise in the area of analysis of levels of living were indicated. The study may be described as empirical, since concrete evidence was presented throughout to substantiate certain propositions and conclusions.

B. Origin of the Study

An adequate and satisfying level of living is a goal deeply rooted in American traditions. It persists strongly as a major goal of farm people, even though its achievement is not always readily or uniformly realized. The failure of many farm families to be securely situated with respect to an adequate and satisfying level of living is to them a continually perplexing problem. The traditional thinking among many people is that a satisfactory level of living is within the reach of any individual, family or group. The

shortcomings of this expectation are a major concern of students of human welfare.

Some areas in Iowa known to the writer seem to be characterized by much uniformity in the levels of living of the families, who appear to be well integrated into the social fabric of those areas. In still other areas, large enough differences in level of living exist so that a lack of integration or unanimity of purpose in community activity becomes apparent. In a study in Ohio, which doubtless has implications for other areas, Mangus and Cottam found evidence to

> . . . indicate a highly significant relationship between level of living and total adjustment. Statistical tests provide assurance that this relationship is characteristic among Ohio farm people in general, as well as among those included in the sample. A high level of living does not guarantee contentment nor a low level of living its opposite; nevertheless, the chances of a completely satisfactory life are probably from three to four times greater for those near the top of the scale of living than for those near the bottom.[1]

In a study of Oklahoma farm families, Sewell arrived at the same general conclusion as the Ohio authors.

> Differences in socio-economic status among families are observed readily by all who study human social behavior. That these differences profoundly affect members of the family, especially the children is a well accepted fact. That the individual's conception of his social role is definitely conditioned by his home background is one of the fundamental premises upon which modern social psychology,

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[1] Mangus, A. R. and Cottam, Howard R. Level of living, social participation and adjustment of Ohio farm people. Ohio (Wooster) Agr. Exp. Sta. Bul. 624. 1941. p. 27.

> child guidance, and sociology are predicated. That a family will struggle to raise its status if it is low, or fight to maintain it when it is threatened, is a fact apparent in all societies.
>
> Students of rural society, no less than others, have long been aware of these facts. Likewise, they have recognized that differences in socio-economic status so greatly influence the social behavior of rural people that it is necessary to control this factor in studies where other aspects of behavior are being compared.[1]

Despite the large number of level of living studies which have been made, little is yet known about areal variations in levels of living and the whole complex of factors operating in each area. Nor is much known about the effect of areal variations in levels of living on social behavior of families and groups within each of the areas. A succinct summary of the history of studies of family living in the United States and Canada indicated that

> . . . there has never been a comprehensive study of the living of all groups in the population. More than that, there has never been an adequate study of the living of all the social and economic groups in any one state or in any one city.
>
> Studies of farm family living in certain counties in the United States have received a more adequate representation of all the social and economic groups in the community than have any of the urban studies. There has never been, however, a study of farm family living which included enough communities to give an adequate picture of all the important farm groups in the country. The material so far gathered can be used with the aid of census statistics only to sketch, in very broad outlines, the conditions of living and the consumption habits of the farm population.

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[1] Sewell, W. H. The construction and standardization of a scale for the measurement of the socio-economic status of Oklahoma farm families. Okla. Agr. Exp. Sta. Tech. Bul. 9. 1940. p. 7.

> Studies of family living in Canada are still too few and too small in scope to give any indication of living conditions and consumption habits within the Dominion.[1]

Studies of rural life have involved the consideration of locality groupings as the basic social units of inquiry. Such social units ranged from neighborhoods to communities, cultural areas, sub-regions and regions. Many leading sociologists are identified with particular community studies. The identification of the ecological patterns of farm family levels of living usually was not given serious consideration, although the problem was generally recognized. Various text book authors in the field of rural sociology make some reference to the problem.[2]

Since 1935, most of the studies concerned with areal aspects of levels of living have been confined to analyzing and portraying regional differentials in the well-being of the nation's farm people.

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[1] Williams, F. M. and Zimmerman, C. C. Studies of family living in the United States and other countries: an analysis of material and method. U. S. Dept. of Agr. Misc. Publ. 223. 1935. p. 13.

[2] Kolb, J. H. and Brunner, E. deS. The study of rural society. Boston, Houghton Mifflin and Company. 1946. Chap. 7.

Sanderson, Dwight and Polson, Robert A. Rural sociology and rural social organization. N. Y., John Wiley and Sons. 1942. p. 121-125.

Smith, T. Lynn. The sociology of rural life. N. Y., Harper and Brothers. 1940. p. 336.

Taylor, Carl C. and others. Rural life in the United States. N. Y., Alfred A. Knopf. 1949. Chap. 17 and 18.

Taylor, Wheeler and Kirkpatrick[1], Hagood[2], Schuler[3], Mangus[4], Odum[5], and Odum and Moore[6] may be considered as pioneers in these researches. These gross differentiations were necessary to the more specific and definitive variations in which social scientists recently have become interested. Studies such as those of Lively and Almack[7], Lively and Gregory[8], Hagood, Danilevsky and Beum[9] are examples of the latter approach.

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[1]Taylor, Carl C., Wheeler, Helen W., and Kirkpatrick, E. L. Disadvantaged classes in American agriculture. Wash. D. C., Farm Security Admin. and Bur. of Agr. Econ. cooperating, Soc. Res. Report 8 (Processed). 1938.

[2]Hagood, Margaret Jarman. Farm operator family level of living indexes for counties of the United States, 1940 and 1945. U. S. Dept. of Agr., Bur. of Agr. Econ. (Mimeo.) 1947.

[3]Schuler, Edgar A. Some regional variations in levels and standards of living. Rur. Soc. 9:122-141. 1944.

[4]Mangus, A. R. Rural regions of the United States. Wash. D. C., Work Projects Admin. 1940.

[5]Odum, Howard W. Southern regions of the United States. Chapel Hill. The Univ. of North Carolina Press. 1936.

[6]_____ and Moore, Harry E. American regionalism. N. Y. Henry Holt and Co., Inc. 1938.

[7]Lively, C. E. and Almack, R. B. A method of determining rural social sub-areas with application to Ohio. Ohio State Univ. (Columbus) Dept. of Rur. Econ. Mimeo. Bul. 106. 1938.

[8]_____ and Gregory, C. L. Rural social areas in Missouri. Mo. Agr. Exp. Sta. Res. Bul. 414. 1948.

[9]Hagood, Margaret Jarman, Danilevsky, Nadia and Beum, Corlin C. An examination of the use of factor analysis in the problem of subregional determination. Rur. Soc. 6:216-233. 1941.

Correlation, intercorrelation and regression analyses of level of living and related factors data used by Mangus, Lively, Hagood and Sewell were important contributions to the literature on farm family level of living and helped greatly to remove this area of research from the usual practice of mere description.

The findings of the above mentioned researchers, the general movement in the social sciences toward more definitive spatial delineations of variations in social phenomena, including levels of living, the limitation of much sub-regionalization work in Iowa to type of farming areas and the fact that farm family level of living indexes could be computed for townships gave specific stimulus to this study. The writer assumed that a more precise delineation of the spatial variations in levels of living of farm families could be done. It was assumed further that such delineated variations carry different associational relationships with certain economic, physical and social factors. A secondary consideration growing out of the foregoing was that the use of such identifications and relationships could be employed in other researches to facilitate the discovery and refinement of significant relationships which may be presently obscured.

With so much variation in levels of living among the farm families, the averages for all families on any large formal area basis are of little significance. Many discussions and writings are concerned with problems of raising the levels of living of farm families,

yet it is not always recognized that the wide variations may be the result of varying complexes of factors. Legislation establishing programs affecting farm families is passed which has uniform application to all sectors of the farm population. Policies and procedures for public and private programs often are prepared without due regard to the variable ability of the population to respond to them. Such approaches often defeat the very purpose which they set out to accomplish. They represent the application of uniform treatment to a heterogeneous situation.

C. Plan of Work

When the general purposes of the study had been decided upon, then considerable exploratory work for choice of procedures in the development of the study followed. Limitations were set by the nature and availability of the data. In each of the applicable chapters, procedures and techniques are described, and their usefulness in yielding valid results indicated. How well the choice of procedures and techniques met the demands of a study such as this can be determined only from the added clarification obtained of the existent levels of living among farm families in Iowa.

Any generalizations from this study apply to the farm families as they are included, or excluded, through delineation of any individual area or areas. Ideally, the measure of variation in

levels of living of farm families would be best depicted by an index pertaining to each individual family. However, to study the universe in such detail was not within the province of this effort or within the limitations of the resources available. Furthermore, most types of information on individual families needed for such a study are not available from secondary sources. For most of the analysis in this study farm family level of living indexes by townships served as the basic units. The township was the smallest unit on which much aggregated data could be obtained. It reveals variations not shown by a unit as large as a county, therefore was well adapted for the more precise delineations and for the analysis of relationship of farm family levels of living to selected variables in the various areas.

D. Prosperous, Commercial Agriculture

Commercial agriculture such as enjoyed by Iowa farmers brings a relatively high monetary return to them. The prosperity of the farm firm is likely to be reflected in the level of living of the families. About one-third of the employed workers are in agriculture.[1] A large proportion of the remainder work in industries and services related to agriculture. Farms include 96.2 percent of the land area of the state.

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[1] Unless otherwise noted, the data cited in this section are either quoted or computed from the 1945 and 1950 U. S. Censuses of Agriculture.

Although commercial, Iowa farms are family size rather than large scale. In fact, during 1949 only 40,000 persons, or less than one-fifth of a person per farm, were classified as hired farm workers. Through the use of highly mechanized equipment, increasingly efficient farming methods and improved varieties of crops and breeds of livestock, the farms produce more food each year than can be consumed by the producing family in many years.

In 1945, 40 percent of the farms reported a gross value of products of $5,000 or more per farm. The per acre value of land and buildings was $105, and the per farm reporting value of implements and machinery was $1,868.

The level of living index of farm operator families is an indicant of the prosperity of Iowa farmers. In 1945, the index was 162 as compared to a national average of 100.[1] Five years previous the index was 133.

While on an overall basis the level of living of farm families was high, an examination of the indexes by townships showed a range from 60 to 228.[2] Thus, the families in the high township, on an

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[1] Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945. p. 13.

[2] Folsom, Josiah C. Farm operator family level of living indexes for townships of Iowa, 1945. (Unpublished research.) Wash. D. C., U. S. Dept. of Agr., Bur. Agr. Econ. 1947.

Folsom used Hagood's formula for constructing county indexes to construct indexes for townships. The formula is given in Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945.

average, had a level of living index nearly four times as large as those in the low township.

Iowa farm families when arrayed with those of the nation on any continuum such as poor-prosperous or subsistence-commercial, approximate the prosperous, commercial poles of the continuums.

II. THE FIELD OF LEVEL OF LIVING

A. Introduction

Before entering the methodological phase of this study, it is appropriate to sketch briefly the historical development of level of living studies, to obtain an understanding of what is meant by the term "level of living", to discuss scale analysis as applied to level of living and to elaborate on the measuring of areal differences in levels of living.

B. Historical Development of Level of Living Studies

Several efforts have been made to trace the development of level of living studies here and abroad. The most comprehensive was undertaken by Williams and Zimmerman under the sponsorship of the Social Science Research Council, the United States Department of Agriculture and the Institute of Pacific Relations. They concentrated on an analysis of materials and methods used in 1500 studies of family living in the United States and 51 other countries.[1]

Studies which they selected for review presented data on either total money income or total money expenditures of individual families.

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[1] Williams and Zimmerman, op. cit.

The authors encountered much divergence in the kinds of data presented. Terms used often carried local meaning, and sometimes defied precise classification.

The first studies made in the United States were for the years 1816 - 1817, and the second for 1835.[1] Each was an analysis of household accounts kept by an individual farm family for its own information. No other analyses were found until 1869. From 1869 to 1900, 109 studies were made of families of wage earners, low salaried workers, and small proprietors in the United States; 60 studies were made between 1900 and 1914; and 24 were made between 1914 and 1919.[2] A total of 18 were made on farm families. From 1919 through 1934 studies of farm families exceeded those made of non-farm families by more than two to one, representing a rather significant shift in concern to this occupational sector of the population.

Comparative welfare seemed to keynote many of the earlier studies. Interest was shown in comparing levels of living at home and abroad. Legislation relative to tariffs in the latter part of the 19th century often was conditioned by the findings in such studies. In the early 1900's most of the studies were designed to help solve problems of factory hours and wages.

Periods of rising prices, with maladjustments between purchasing power of customary wages and cost of the customary levels of living

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[1] Ibid., p. 7.

[2] Ibid., p. 7.

resulted in many studies of living expenditures. For example, the United States Bureau of Labor Statistics study made in 1901 of 25,440 families was a result of the rise in prices in 1900.[1] World War I ushered in a number of studies of expenditures, perhaps the most notable being that by the U. S. Bureau of Labor Statistics in 1918-1919 covering 12,096 white families and 741 colored families.[2]

Warren's 1909 study of farm families in Livingston County, New York in which he attempted to attach a monetary value to the whole range of family living was the first of its kind in the United States.[3] This study plus that of Funk's done in 1913, by the Office of Farm Management of the Bureau of Plant Industry, gave stimulus to research which attempted to measure level of living in terms of income and expenditures.[4] It was not until the early 1920's that state agricultural experiment stations became interested in any large scale analyses of farm family levels of living. E. L.

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[1]U. S. Department of Commerce and Labor. Cost of living and retail prices of food. U. S. Department of Commerce and Labor Annual Report 18:15-631, 1904.

[2]U. S. Department of Labor, Bureau of Labor Statistics, Cost of living in the United States. Monthly Labor Review. 8(5): 147-177, 8(6):101-116, 9(1):75-114, 9(2):117-119, 9(5):1-19, 9(6): 29-41, 10(1):27-34, 11(3):83-99, 14(5):77-80. 1920-1922.

U. S. Department of Labor, Bureau of Labor Statistics. Retail prices and cost of living, Ser. Bul. 357. 1924.

[3]Warren, George F. Farm management. N. Y. The Macmillan Co. 1913. p. 21-26.

[4]Funk, W. C. What the farm contributes directly to the farmers' living. U. S. Dept. of Agr. Farmers' Bul. 635. 1914.

Kirkpatrick, then with the Bureau of Agricultural Economics, initiated a project in the period 1922-1924 which resulted in securing data on 2,886 white families in 11 states.[1] Comparisons were made between the families of owners, tenants and hired men, and between these families and other farmers' and workingmen's families. Data from this and the preliminary reports prepared by Kirkpatrick and one or more representatives in each of the states were used widely as representative of the situation of farm families in the United States. The Bureau of Agricultural Economics index of the prices of commodities farmers buy for family use was constructed in part from information obtained by this study. Kirkpatrick, while not the first researcher, perhaps more than any other single individual contributed at that time to the interest in the welfare of the farm population.

The studies briefly surveyed showed that nowhere had there been any concerted attempt to include enough communities or contiguous areas to give an adequate picture of the spatial variation in levels of living.

The depression period of the 1930's contributed appreciably to the growing awareness of the intricate complex of population, environment and culture. More than before, researchers began to

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[1] Kirkpatrick, E. L. The farmer's standard of living; a socio-economic study of 2,886 white farm families of selected localities in 11 states. U. S. Dept. of Agr. Bul. 1466. 1926.

realize that no one part could be understood except in relation to the whole. Odum and Moore insisted that a regional approach was basic to the understanding of human affairs.[1] Ten years earlier Mukerjee emphasized the need for studying the regional complex as an inseparable whole.[2] Other studies that carried forward the regional and sub-regional approaches were mentioned in Chapter I.

C. Level of Living Defined

Out of the vast array of level of living studies, a number of definitions of "level of living" have been proposed. With the advent of multiple factor scales and indexes, the term "level of living" took on a more complex connotation than that of merely a summation of all expenditures. Several of the currently prevailing definitions will be presented.

Williams and Zimmerman spoke of level of living"as a summary term when comparing the content of one living with another, or with a standard, or when generalizing about the content of living of a group".[3] They used the term "standard of living" to "mean an ideal or norm of consumption".[4]

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[1] Odum and Moore, op. cit.

[2] Mukerjee, Rodhakamal. Social ecology of a river valley. Sociol. and Soc. Res. 12:341-347. 1928.

[3] Williams and Zimmerman, op. cit., p. 4.

[4] Ibid., p. 4.

Mangus and Cottam stated that a level of living of a family

> . . . sometimes referred to as its scale of living, plane of living, or socio-economic status consists of the nature and quantity of goods and services possessed at a given time or consumed during a given period. Under the concept, level of living, are included materially measurable possessions of all sorts; household conveniences, land and business accessories, income, health, education, and a host of related acquisitions which imply activities that are directed toward the satisfaction of biological requirements and cultural and social needs. . . .The standard of living implies a group way of life that brings a maximum amount of satisfaction to each individual member of the group. . . .Level of living is. . . a segment of standard of living.[1]

Leagans had this to say about level of living:

> In the sense in which the term is most frequently used, "level of living" refers to the actual expenditures of individuals or family groups. It implies the creation of a composite picture of prevailing choice patterns of economic goods and services consumed by an individual or family. It is the status which a person or family occupies with reference to the ownership and consumption of prevalent types of goods and services. The level of living, therefore, is essentially the summation of all the consumption choices made by the members of a given family.[2]

Longmore and Taylor pointed out that

> . . . an established level of living consists of considerably more than . . . necessities. It is a complex or cluster of habits or standards which are considered by the family to be fairly rigid social or cultural requirements. Thus, to have not mere shelter but housing which meets acceptable standards; not merely to be clad, even well clad, but to be acceptably well dressed; to educate one's children, and to

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[1]Mangus and Cottam, op. cit., p. 9.

[2]Leagans, J. P. The educational interests of farm operators in North Carolina as related to work of the cooperative agricultural extension service. Unpublished Ph.D. thesis, Chicago, Ill. Univ. of Chicago Library, 1949. p. 106.

> participate in institutional, community and recreational activities are social and cultural desires which are relatively imperious. Physical necessities plus these culturally or socially stimulated desires apparently tend to make farm families resist any sharp decline in their accustomed levels of living.[1]

In the development of the level of living indexes for farm families by counties in the United States, Hagood and Ducoff used the following working concept of level of living, as

> . . . the level of current consumption or utilization of goods and services, with services being broadly interpreted to include both publicly furnished and privately secured services which contribute to well-being or provide satisfactions.[2]

Then to focus attention on the distinction between a level of consumption and income they said,

> The level of consumption and utilization of goods and services during a specified period of time is not identical with an income or expenditure level since consumption expenditures may exceed or fall short of the income in the specified period, and since the utility obtained from goods and services currently used is by no means strictly identifiable with current consumption expenditures. Furthermore, a given expenditure level may represent for different families or individuals widely different quantities of goods and services consumed which are not purchased, and differences in budget management. Hence a measure of level of living is not merely a substitute for a measure of income or family living expenditures, since the concept, although closely related, is clearly differentiated.[3]

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[1] Longmore, T. Wilson and Taylor, Carl C. Elasticities of expenditures for farm family living, farm production, and savings, United States, 1946. Jour. of Farm Econ. 33:2-3. 1951.

[2] Hagood, Margaret Jarman and Ducoff, Louis J. What level of living indexes measure. Amer. Soc. Rev. 9:78. 1944.

[3] Ibid., p. 78.

All of the foregoing definitions are in agreement on the consumption of material goods and services as a measure of level of living. With respect to the non-material elements, some of the definitions broadly interpret level of living to include all activities directed toward the satisfaction of cultural and social needs. Other definitions are more modest. Inasmuch as this is a methodological study and use is made of township indexes constructed with the Hagood formula, interpretations will be in the general framework of the Hagood and Ducoff definition.

D. Use of Scales in Analyses of Levels of Living

An important trend in the social sciences during the past few decades has been the increasing development and use of measuring instruments, commonly referred to as scales. A number of scales have been constructed and used to measure level of living, standard of living and socio-economic status. While definitions of these three terms are not identical, from a statistical point of view, the same type of scale or index is used to measure these social phenomena.[1]

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[1] The terms "scale" and "index" in much of the literature are used interchangeably. A scale however is usually used to indicate position on a continuum while an index is usually used to measure the departure from or the relative relationship to some norm or average.

Perhaps the best known of the early scales was that of Ernst Engel developed in 1895.[1] In setting up his scale, Engel employed a unit called quet in honor of Quetelet. This unit was based on the average consumption of an infant. With the passing of each year of growth, .10 quets were added up to 25 years for men and 20 years for women. While this was an arbitrarily determined unit, it served to stimulate the development of more scientific units. As the result of his researches, Engel evolved his law of consumption for which he is best known. Zimmerman stated the law in the following terms: "The proportion of the outgo used for food, other things being equal, is the best measure of the material standard of a population."[2]

Single factor indexes of levels of living were commonly used in earlier attempts at stratifying farm families. An elaborate discussion of this may be found in Sewell's study in Oklahoma.[3] Tenure and occupation were the most frequent types of single factor indexes used. Sewell maintained, "At best they [single factor indexes] differentiate only between extreme levels."[4]

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[1] Engel, Ernst, Lebenkosten Belgischer arbeiterfamilien fruher und jetzt. Bul. de l'Inst. Internat. de Stat. 9:1-124, 1895.

Zimmerman, C. C. Consumption and standards of living. Philadelphia, D. Van Nostrand Co. 1936. p. 39.

[2] Ibid., p. 39.

[3] Sewell, op. cit.

[4] Ibid., p. 9.

Of income as a single factor he said that ". . . when used without due consideration of size, age, and sex composition of the family, it becomes an almost useless index."[1]

Other reasons dictate the unacceptability of income alone as an index of level of living. Many studies have resorted to a single year income figure rather than an average for a series of years. A "normal" year of income cannot be ascertained. Wide variation exists between gross and net income. Some enterprises on farms yield a large income, but involve a large expense and small net return. Others yield a small gross income, but, relatively speaking, a large net income. Gross income data tend to exaggerate the real difference between the living levels of families on different types of farms, or between years where a shift in enterprises takes place. If it is assumed that changes in living levels are, in part, the delayed function of changes in income, researchers using income as a crude measure of level of living should use no less than the average of a series of years immediately preceding that for which an index is being obtained.

In 1923 E. L. Kirkpatrick set up a series of cost-consumption unit scales for farm families.[2] These included separate scales for

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[1]Ibid., p. 9.

[2]Kirkpatrick, E. L. The standard of life in a typical section of diversified farming, N. Y. (Ithaca) Agr. Exp. Sta. Bul. 423. 1923.

_____ and Tough, E. G. Comparison of two scales for measuring the cost and value of living. Amer. Jour. of Soc. 37:424-434. 1931.

food, clothing, rent, maintenance of health, advancement, personal goods and furnishings. A weakness of this approach was the lack of a summary unit or index. Its strength was in the consideration of a multiple of factors.

A scale that has been used in studies of farm family income and consumption was one developed by Zimmerman and Black in 1927.[1] The uniqueness of this scale was that the consuming power for all goods and services of an adult male 19-60 years of age was considered to be unity. Twelve age and sex classifications were included, thus permitting combinations for all kinds of age and sex distributions within families.

Our present day reliance on multiple-factor indexes dates back to John R. Commons' use of a dwelling house score card in housing investigations in 1908.[2] Items on the card included location, congestion, ventilation, lighting, condition of house, appurtenances, sleeping arrangements, number of occupants, and cleanliness. Though unstandardized and arbitrarily constructed, the scale provided suggestions for later developments in multiple-factor scale construction.

Scales by other researchers followed in rapid succession. Several will be mentioned here. Perry published a Manner of Living

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[1] Zimmerman, C. C. and Black, J. D. How Minnesota farm family incomes are spent: an interpretation of a one year study. Minn. Agr. Exp. Sta. Bul. 229. 1927.

[2] Commons, John R. Standardization of housing investigations. Jour. Amer. Stat. Assoc. 2:319-326. 1908.

Index in 1913.[1] Arbitrary weights were assigned to each of several articles used in each of the four most important rooms in the house. An index was computed by dividing the sum of the ratings by some pre-established standard. This was probably the first index to include actual home conditions.

Mumford, Thaden and Spurway designed a score card to study farm family living.[2] Arbitrary weights were assigned to each of its six parts: home equipment, arrangement and surroundings; family practices; schooling, reading and extension affiliations; art and recreational activities; organization and institutional affiliations and attendance; and leadership and civic responsibility. Because the score card was not standardized, its value was open to question. However, it appeared to have relatively good balance between material and non-material elements.

Standardization of scales for urban families began about 1925, and helped provide some of the basis for the later construction of a rural scale. Chapman and Sims administered the first standardized scale to high school students.[3] The scale was designed to cover

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[1] Perry, C. A. A measure of the manner of living. Amer. Stat. Assoc. Quart. Publ. 13:398-403. 1913.

[2] Mumford, E., Thaden, J. F. and Spurway, M. C. The standard of living of farm families in selected Michigan communities. Mich. Agr. Exp. Sta. Bul. 287. 1937.

[3] Chapman, J. and Sims, V. M. The quantitative measurement of certain aspects of socio-economic status. Jour. of Ed. Psych. 16:380-390. 1925.

occupation and education of parents, reading matter in the home, and possession of automobile, telephone and radio. This was one of the first efforts at limiting the number of items to a manageable size, and at the same time demonstrating the advantage of a multiple-factor scale.

Chapin began work about 1928 on the development of what he called a Social Status Scale.[1] Emphasizing material possessions only, the scale is brief, relatively simple and well standardized for determining the socio-economic status of urban families.

A. M. Leahy, also in Minnesota, designed the Home Status Index to measure the material elements in the home environment.[2] Fifty items were included, grouped into six categories as follows; children's facilities; economic status; cultural status; sociality; occupational status; and educational status. Weights were assigned statistically. This index is regarded as one of the better standardized instruments for measuring level of living.

With this background on urban families, Sewell constructed and standardized a scale in 1940 for use on unbroken rural farm families.[3] Thirty-six out of more than 123 material and non-material

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[1] Chapin, F. Stuart. The measurement of social status. Minneapolis, Univ. of Minn. Press. 1933.

[2] Leahy, A. M. The measurement of urban home environment. Minneapolis, Univ. of Minn. Press. 1936.

[3] Sewell, op. cit.

items tested were retained for construction of the scale. Fifteen items represented the material possessions component of the scale; 13, the cultural possessions component; and eight, the social participation component. The scale has been widely used in various sociological studies for socio-economic stratification of farm families.

This brief survey of the development of the more important scaling techniques used to measure socio-economic status showed that: (1) most of the early attempts at measuring socio-economic status were of the single factor type; and, (2) as an outgrowth of experience with the single-factor indexes and their limitations, social scientists turned to the development of multiple factor scales. Improved statistical techniques have contributed markedly to the standardization of such scales.

Practically all of the above mentioned scales lack adaptability for measurement of living levels over large areas except at great expense. Most have been used to arrive at a general statement of the level of consumption, rather than trying to arrive at spatial areas in which living levels follow a similar pattern. While the tremendous amount of research done with the above scales has been of immeasurable value and has contributed to explorations on an areal basis, it would appear logical that measurement on an areal basis should precede or be supplemented by the scales of more limited application. The combination of the two approaches would provide

an existent pattern or configuration of level of living differentials within which the detailed and specific aspects of a study could be undertaken. In this manner a specific frame of reference could be provided within which stated hypotheses could be tested.

Raper and Taylor have made reference to this:

> The concept of the cultural area or region is of basic importance to the social scientist, and to the rural sociologist especially, for it provides a means whereby the spatial aspects of society can be broken down into broadly and relatively homogeneous locality units. This type of delineation makes it possible for scientists to deal with the separate areas as segments of a unified whole - a type of analysis greatly needed to supplement the economic and population analyses that have been done on these same geographic bases, and to supplement and enrich the findings of specific studies that have been made of such subjects as levels of living, leadership, delinquency, family organization, and youth participation in group activities. Studies of cultural areas and of specific subject matter fields will supplement each other in many important ways. In fact there is a dawning realization that neither can be done adequately without the other.[1]

E. Measuring Areal Differences in Levels of Living

One of the first attempts to determine differences in farm family living levels among rural areas was in Ohio by Lively and Almack in 1938.[2]

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[1] Raper, Arthur F. and Taylor, Carl C. Rural culture. In Taylor, Carl C. and others. Rural life in the United States. p. 339. N. Y., Alfred A. Knopf. 1949.

[2] Lively, C. E. and Almack, R. B. op. cit.

The study was based on census and other data available by counties. On the basis of intercorrelation analysis six components demonstrating discriminating capacity on a county basis were selected: average value of farm dwelling; percentage of farms reporting radios; percentage of farms reporting telephones; percentage of farms reporting electricity; percentage of farms reporting running water and percentage of farms reporting automobiles. One advantage of this index was that it provided an easily applicable method for determining levels of living by counties for the rural population in Ohio.

Mangus used a similar set of components for the level of living variable which was one of seven he used for delineating the rural regions of the United States.[1] The components were: average value of the farm dwelling; the percent of farms having automobiles; the percent of farms having electric lights; the percent having running water piped in the house; the percent having telephones; and the percent having radios, 1930.

Since the Ohio study, Lively and Gregory have pursued a similar type of study in Missouri.[2] Their procedure involved three steps: (1) the selection and weighting of variables upon which the delineation was to be based; (2) using the variables to delimit the areas; and (3) testing to determine the validity of the work.

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[1] Mangus, op. cit., p. 79.

[2] Lively, C. E. and Gregory, C. L. Rural social areas in Missouri. Mo. Agr. Exp. Sta. Res. Bul. 305, 1939.
Lively and Gregory, Rural social areas in Missouri. 1948.

Starting out with a large number of variables, Lively and Gregory found through correlation analysis of all possible combinations that two major indices set a pattern around which the rest could be grouped. By superimposing the regional pattern of one index on that of another, it was then possible to delimit sub-areas, i.e. homogeneous groups of counties. The authors maintain that while the technique worked in Missouri there is, as yet, no assurance that it will be satisfactory in other states or areas. Once having delineated the rural social areas, the authors found that over time the boundaries changed only slightly. Special researches in sociological subjects at the University of Missouri have used the areas.

While the Ohio and Missouri studies represent the earliest work in rural social area delineations, and that of Mangus the first to delineate rural regions; Goodrich and associates constructed a plane of living index for total county populations.[1] Rural and urban populations were not treated separately. Criteria used were: income tax returns; number of residence telephones in use; and, number of families who reported radio sets. The authors made no claim for the validity of their index, only that this method had produced in broad outlines some knowledge of the general welfare of the people of the nation. It was not adapted to very exacting delineations.

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[1] Goodrich, C., Allen, B. W. and Hayes, M. Migration and planes of living. Philadelphia. Univ. of Penn. Press. 1935. p. 13-27.

The Hagood indexes referred to earlier, and which provide the working basis for this study, were the latest developed.[1] They were constructed as "general purpose" indexes to be used chiefly in delineation of areas or regions for both administrative and research purposes, and for analyses of the relationships of "level of living" to various social and economic phenomena.

The 1940 indexes consisted of five components: (1) percentage of occupied dwelling units with 1.5 or fewer persons per room; (2) percentage of dwelling units with radio; (3) percentage of farms with gross income of more than $600; (4) percentage of farms reporting autos of 1936 or later models, and (5) median grade of school completed by persons 25 years of age and over. The five components were selected and weighted by the factor analysis method.[2]

The 1945 indexes consisted of four components: (1) percentage of farms with electricity in farm dwelling, 1945; (2) percentage of farms with telephone in farm dwelling, 1945; (3) percentage of farms with automobiles, 1945; and (4) mean value of products sold or traded per farm reporting, 1944.[3]

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[1] Hagood, Margaret Jarman. Rural level of living indexes for counties of the United States, 1940. U. S. Dept. of Agr., Bur. of Agr. Econ. (Mimeo.) 1943.
Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945.

[2] Hagood, Margaret Jarman. Development of a 1940 rural-farm level of living index for counties. Rur. Soc. 8:171-180. 1943.
Hagood, Construction of county indexes for measuring change in level of living of farm operator families, 1940-1945. Rur. Soc. 12:139-150. 1947.

[3] Hagood, Farm operator family level of living indexes for counties of the United States, 1940-1945.

Hagood presented a short description of the method she used in the construction of the 1945 index formula.

> Construction of the formula for combining information on items in the indexes involved the obtaining of weights through component analysis of the intercorrelations among the four items. This method of obtaining weights assumes that the items should be combined in such a way as to provide a composite measure of the highest factor they have in common. This is the factor which can best be measured by the given items and it is assumed to represent an approximation to "level of living."
>
> To expedite the construction of the indexes, the preliminary work was limited to a national sample of 196 counties. With certain supplementary counties, this was used by the Bureau of the Census for early processing of the results from the 1945 Census of Agriculture to obtain national and regional estimates before complete tabulations were available. The stages in development of the index formula from the correlations for this sample of counties is shown in the (following table). The formula for 1945 is as follows:
>
> $$1945 \text{ Index} = .538X_1 + .603X_2 + .617X_3 + .460X_4,$$
>
> with the subscripts of the items referring to the identification numbers used in the (following table).
>
> One modification was required in the formula for use in computing comparable index values for 1940. To allow for the higher purchasing power of the farmers' dollar in 1939 than in 1944, the average value of products sold or traded as reported for 1944 could have been increased by 37.1 percent before applying the 1945 index formula. For computing purposes it was simpler to multiply the weight for this item, X_4, by 1.371. This results in the following formula for 1940 data:
>
> $$1940 \text{ Index} = .538X_1 + .603X_2 + .617X_3 + .631X_4,$$
>
> with the subscripts of the items referring to the identification numbers used in the (following table).

Stages in development of index formula from intercorrelations of four items related to farm operator level of living, sample of 196 counties, 1945

Identification of item [1/]	Identification number of item /1			
	1	2	3	4
	Correlations of items with each other			
1	--	.622	.715	.450
2	.622	--	.794	.489
3	.715	.794	--	.537
4	.450	.489	.537	--
	Correlations of items with principal component			
	.836	.877	.920	.713
	Standard deviations of items			
	26.0	24.3	24.9	26.0
	Correlations of items with principal components divided by standard deviations of items			
	.0322	.0361	.0369	.0275
	Weight for each item in index formula (Weights coded by multiplying preceding line times 16.71 to make the U.S. mean equal 100 and zero value on all items equal zero.)			
	.538	.603	.617	.460

[1/] **Identification of items:**

1 = Percentage of farms with electricity in farm dwelling, 1945.
2 = Percentage of farms with telephone in farm dwelling, 1945.
3 = Percentage of farms with automobiles, 1945.
4 = Mean value of products sold or traded per farm reporting, 1944 (in hundreds of dollars).[1]

[1] Ibid., p. 40-41.

While considerable use has been made of the group type of indexes, little has been written on the nature of these indexes, the "content" of them, or on the concept of level of living as applied to a group average.[1] Hagood and Ducoff in attempting to indicate what a level of living index measures pointed out:

> . . . (1) that an index is not a direct measure of the actual level of living, but only an indicant of it; (2) that such an indicant for a county is not of the absolute degree of attainment of some external standard, but is expressed in relation to the corresponding degree of attainment for a defined group (e.g. the average of all counties); (3) that the description of level of living relates only to the average level attained by the specified residence class of the county, and not to variations in the level of living present among the individual families or persons.[2]

Clearly an index made up of a small number of components indicating level of living for a population such as that of a county or township is not satisfactory for use in measuring the level of living of an individual or of a single family. The unique deviations in consumption patterns of an individual necessitate a scale with sufficient components to produce a reliable indication of the level of living of that individual. Those who have constructed scales for measuring level of living of families or individuals found that reliability was usually lost when the number of items was reduced.

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[1] Exceptions to this include: McKain, Walter C., Jr. The concept of plane of living and the construction of a plane of living index. Rur. Soc. 4:337-343. 1939.
Hagood and Ducoff, op. cit., p. 78-84.

[2] Ibid., p. 79.

It does not necessarily follow, however, that indexes should consist of large numbers of components. Those who construct indexes usually are limited by the necessity of selecting such components as are prevalent for the entire nation or other large area and which have attained general acceptance.

Most indexes have relied rather heavily on such items as percent of farm families having radios, telephones, electricity, automobile and running water in the home. As increasing proportions of farm families acquire these items, other components will have to be used in index construction in order that areal differences in levels of living may be reliably determined. Suggested types of components might consist of: (1) a record of income and of expenditures for family living for every rural-farm family in the nation; (2) a record of family produced goods and services; (3) some kind of an inventory of goods used in family living; (4) an inventory of publicly supplied goods and services that were consumed; and (5) extent of social participation. Basically, this would amount to a beginning and ending inventory for all carryover goods and services plus an itemization of all between inventory consumption and participation. Construction of an index with these suggested components will have to await a more complete enumeration of such information by the census or some other agency. As public interest in areal level of living differentials grows, an increasing body of such information may be expected to become available.

Summarily, the study of areal variations in levels of living represents one phase of an ecological approach to the study of rural social phenomena. A more complete approach suggests the necessity of examining social phenomena in terms of all relevant ecological contexts for an adequate understanding of their significance. Once the coexistence of a number of ecological areas of influence with reference to any population has been demonstrated, it would seem to be a reasonable assumption that specific rural problems could be attacked within the framework of the appropriate ecological structure. While this study is not on problems of the areas per se, it is concerned with the ecology of levels of living in Iowa.

III. METHODOLOGY AND PROCEDURE

A. Introduction

Discussion in Chapters I and II has sketched in some detail the attention that has been given to the problem of ascertaining levels of living. The historical and contemporary perspective for the research was described. The paucity of measures and the small amount of research of level of living on an areal basis were indicated.

The basic methodology and procedure used in this dissertation are formulated, and the various techniques of analysis are briefly described in this chapter. Sources of data and their quantitative and qualitative characteristics are presented. Such a digression is necessary, since the investigation is methodological and exploratory and, in some cases, lacks the preciseness of straight-forward statistical analysis. No effort is made to explore the interesting theoretical considerations, nor to consider the dialectics on some of the methods.

B. Selection of Techniques of Analysis

The problem in this study is an attempt to develop and/or to apply some alternative methods and techniques which will raise the level of understanding of differentials in levels of living and

related factors in Iowa. After a critical review of recent level of living studies and through an awareness of the many problems of areal planning, this research seemed to offer fruitful possibilities.

The problem was selected because: (1) previous investigators had pointed up the crudity of using states, and even counties, as units for delineating farm family levels of living, suggesting that units as small or smaller than a township would be more satisfactory; (2) the validity and usefulness of the Hagood level of living indexes generally has been accepted; (3) the formula used in developing the Hagood indexes could be applied with equal facility to similar data on a township basis; and, (4) researchers in a number of states are using the township indexes to good advantage in planning and executing researches on areal bases, and action agencies have used the information for planning programs.

Methods and techniques of analysis proceeded from an examination of farm family level of living in the usual manner of simple geographic variation and statistical variation to the more intensive analyses using analysis of variance, simple correlation, multiple correlation and multiple regression to determine not only extent of variation in level of living, but relationship of level of living to selected social and economic variables for the state as a whole, and to determine the collective and individual predictive value of the variables on level of living. In general, similar analyses were carried out by type of farming areas, by soil

association areas, and by homogeneous and non-homogeneous level of living areas. The homogeneous and non-homogeneous areas were delineated on the basis of contiguity of townships having uniform level of living indexes. Finally, the ecology of farm family level of living and of selected social and economic variables was ascertained by determining the extent to which the variables for each township ranked in relationship to level of living. Results were presented statistically and graphically. As each method and technique is unfolded and results indicated, implications are stated. The results of the research are then summarized.

C. Sources of Data

Many types of information relative to social and economic factors found on a county basis were not obtainable for townships except in unpublished form. For this study, arrangements were made for obtaining information in whatever forms available. Below is a listing of the types of information compiled, together with their sources. Both published and unpublished data were utilized.

1. Farm operator family level of living index, 1945 - compiled by Josiah C. Folsom by using for townships the 1945 formula developed for counties, published in Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945, p. 40.[1]

[1] Folsom, Josiah C., op. cit.

2. Size of farm, 1945 - computed from unpublished data in the files of the Iowa Crop and Livestock Reporting Service.[1]

3. Percent of farm land tenant operated, 1945 - computed from unpublished data in the files of the Iowa Crop and Livestock Reporting Service.[2]

4. Mechanization index per 100 acres, 1945 - computed from unpublished data in the files of the Iowa Crop and Livestock Reporting Service.[3] To compute the index, each tractor, because of its more frequent use throughout the year was assigned a value of 3; combines, corn pickers, and hay balers each a value of 1. The resulting total was divided into the hundreds of acres in farms in the township for the index value.

5. Crop productivity index, 1940-1944 - as computed by the Iowa Crop and Livestock Reporting Service represents the total production in pounds of all grains and seeds (including corn, oats, soybeans, wheat, barley, rye, flaxseed, popcorn, clover, alfalfa, and timothy) for each township for the five year period. An index of 100 was set to represent the state average for the five year period.[4]

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[1] Iowa Crop and Livestock Reporting Service. Iowa assessors annual farm census, township record, 1945. (Unpublished data). Des Moines, Ia., Dept. of Agr.

[2] Ibid.

[3] Ibid.

[4] Iowa Crop and Livestock Reporting Service. A graphic summary of Iowa crop yields and land productivity by townships, 1940-1944. Des Moines, Ia. Dept. of Agr. Bul. 92.5. 1947. Fig. 10.

6. Corn yield, bushels per acre, 1940-1944 - obtained from Iowa Department of Agriculture Bul. 92.5.[1]

7. Value of implements and machinery per 100 acres, 1945 - computed from unpublished data by minor civil divisions on file U. S. Bureau of the Census, Agriculture Division.[2]

8. Value of land and buildings per acre, 1945 - computed from unpublished data by minor civil divisions on file U. S. Bureau of the Census, Agriculture Division.[3]

9. Percent rural farm population is of total population, 1940 - computed from data from the U. S. Census of Population, 1940.[4]

10. Percent 1940 population is of the 1900 population - computed from total township population from U. S. Census of Population for the decennial years 1900 and 1940.[5] The decennial year 1900 was used as the base year with an index of 100. Values given for 1940 represent the percent the 1940 population is of the 1900 population.

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[1] Ibid., Fig. 2.

[2] U. S. Bureau of the Census, Agriculture Division. Value of implements and machinery by townships, 1945. (Unpublished data.)

[3] U. S. Bureau of the Census, Agriculture Division. Value of land and buildings by townships, 1945. (Unpublished data.)

[4] U. S. 16th Census: 1940. Population, 2, pt. 2:926-966. 1943.

[5] U. S. 14th Census: 1920. Population, 1:414-426. 1921.
U. S. 16th Census: 1940. Population, 1:367-378. 1942.

11. Percent of population foreign born and of foreign or mixed parentage, 1930 - computed from U. S. Census of Population, 1930.[1] Similar information for 1940 was not available.

12. Township participation rating score, 1938 - represents a measure of interests and participation of local people and the use of local volunteer leaders in county extension work during 1938. Participation ratings were from the Standard Farm Bureau Score Card covering: (1) local interest and support; (2) leadership; (3) activities; and, (4) results accomplished.[2]

13. Type of farming areas - obtained from Iowa Agricultural Extension Service, Background of Iowa Agriculture.[3]

14. Principal soil association areas - basic information obtained from Riecken and Smith, Principal upland soils of Iowa.[4] Slight modifications were made in the soil associations map shown opposite p. 2 in the above publication for this study. Persons assisting in these changes in addition to the above authors were A. R. Aandahl and F. L. Thompson, all staff members of Iowa State College Agronomy Department.

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[1] U. S. 15th Census: 1930, Population, 3, pt. 1:796-816. 1933.

[2] Iowa Agricultural Extension Service. Information on township participation rating score, 1938. (Unpublished.) Ames.

[3] Iowa Agricultural Extension Service. Program Planning Committee. Background of Iowa agriculture. (Processed) Ames, Ia. Agr. Exten. Serv. 1948.

[4] Riecken, F. F. and Smith, Guy D. Principal upland soils of Iowa. Ia. Agr. Exp. Sta. Agron. 49. (Rev.) (Mimeo.) 1949.

Certain of the types of computations indicated above were arbitrary, however the rates or averages derived follow the usual precedent set for such. In the remainder of this study the above listed variables generally will be referred to in abbreviated form as follows: farm family level of living; size of farm; percent tenancy; mechanization index; crop productivity; corn yield; value of implements and machinery; value of land and buildings; percent rural farm population; percent 1940 population is of the 1900 population; percent of population foreign born and of foreign or mixed parentage; township participation rating score; type of farming areas; and soil association areas.

D. The Quantitative and Qualitative Characteristics of the Data

In general the data of the investigation were quantitative. In some cases the quantitative aspects of the data were relatively precise measures of the variable in question; in other cases some of the quantitative data lacked the preciseness that might be desired. For example, crop productivity was the only statistical measure of soil productivity readily available. Since managerial ability is still another variable which has a bearing on ability of soil to produce, the crop productivity index becomes a relative figure, the result of a given state of arts plus geographic and climatic conditions.

Township participation rating, soil association areas and type farming areas, while supported and often based on quantitative data, were based in part on judgment. To this extent they were of a more qualitative nature than those factors based on enumerated data only.

While the following analyses largely are statistical in nature, the investigator does not insist that any term or concept, operationally defined, can be handled in a statistical manner. The issue of certain sociological factors being statistically measured is pertinent. Thus, if level of living is a sociological factor, to what extent is the index a measure of certain social behavior or of human interrelationships and satisfactions? Which is more significant the level as indicated by the index, or the quality of living? A family may possess all of the material comforts of life, yet not know how to use them in a manner that will maximize human satisfaction. The qualitative aspects of a given level of living may be only inferred from the statistics that indicate a given level. Because the concern here is with group phenomena, the average level of living in a given township or area represents a smoothing out of the wide family to family or person to person variations. To the extent that the level of living index is viewed as an average, it may be interpreted with a high degree of confidence.

IV. FARM FAMILY LEVEL OF LIVING IN IOWA

A. Introduction

Even though in a generalized sense Iowa, as a state, is a segment of a larger universe of similarities, a number of dissimilarities exist within its borders. This chapter is concerned with the identification of similarities and dissimilarities in levels of living of farm families. The descriptive and statistical treatment was designed to present an overall view of the situation in the state; to determine the relationship of the several variables to level of living; to determine the usefulness of those variables for predicting level of living; and to provide the background for the analyses in the succeeding chapters.

The level of living measured by the indexes used in this study is a composite of many characteristics, some of them measurable, some perhaps not--which tend to be present when and to the degree that the index items are present and reflect such characteristics.

The indexes were developed for townships through use of the formula for the county indexes as discussed in Chapter III. The average of all township indexes was 164, that of county indexes was 162. A slight departure in the preparation of the two indexes, however, should be noted. Data for preparation of the county indexes

included farms in incorporated places, that for township indexes excluded them.

The average number of farms per township in Iowa in 1945 was 122.6, with the smallest number of farms outside incorporated areas in any township being five. Indexes for 23 of the townships with fewer than 50 farms outside incorporated places were combined with those of adjoining townships. Thus, all computations and the analysis have been on the basis of 1,586 township units.

B. Variations in Levels of Living - Geographic

In 1945 the mean farm family level of living index for all counties for the state was 162. Only Connecticut and New Jersey, with indexes of 170 and 176, respectively, ranked higher in the nation. The mean for the United States was 100. The range by counties was from 5 to 457.

The mean index of 100 did not represent a perfect score, nor did it represent a particular standard. It meant only that a county with an index of 100 was at about the average of all counties in the United States in 1945.

Townships in Iowa differed widely in the average level of living attained by their farm families, ranging from a low index of 60 to a high of 228, or nearly four times that of the low index. The variations by townships in farm family level of living are shown in Figure 1. Townships in the two lowest index groups of under 140,

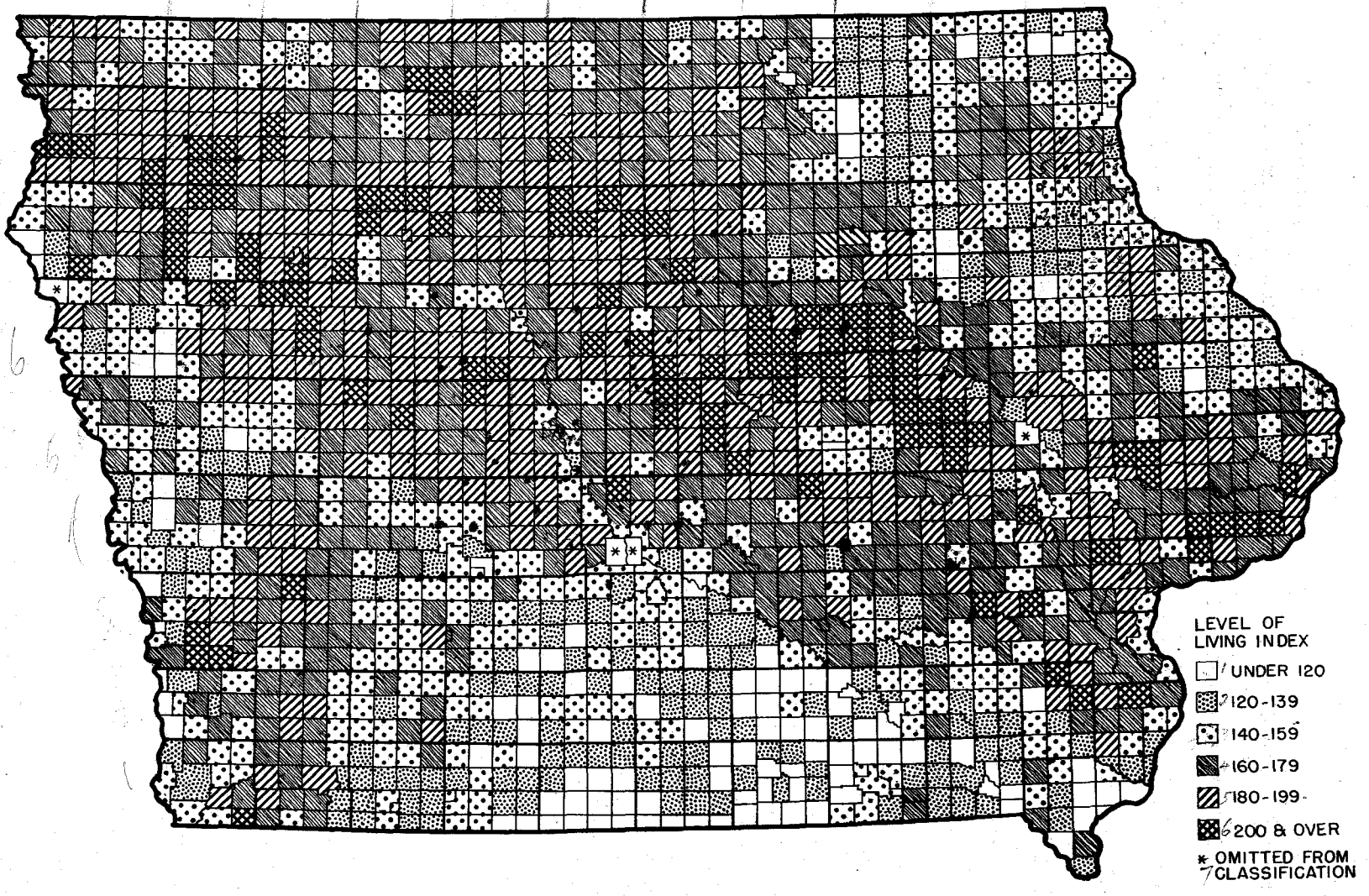

Fig. 1. Farm family level of living by townships, Iowa, 1945.

representing about one-fifth of the townships in the state, were located in the south, west and northeast parts of the state. At the other extreme the two highest index groups, again representing approximately one-fifth of the townships, extended from southeast Iowa to northwest Iowa with some scattering of high index townships in northeast Iowa and in an area extending from the west north central to the west southwest parts of the state.

In general, the townships in the lowest fifth were adjacent to those of the next highest fifth, while those in the next to the highest fifth were adjacent to the highest group. The fifth of the townships represented by the index level of 140-159 appeared to have the least propensity for contiguity or tendency to cluster of any of the index levels of townships.

The area bounded on the northeast by the lower reaches of the Wapsipinicon river and on the southwest by the lower reaches of the Des Moines and Middle Raccoon rivers includes most of the townships in the state that show high farm family level of living indexes, Figure 2. In bread outlines, this encompasses much of the East Central Meat and the North Central Grain type of farming areas. See Figure 7.

Levels of living were found to vary widely, often within small areas. For example, ranges from the lowest to the highest level of living index intervals were found in several of the counties. A tabulation of counties by ranges between high and low township farm

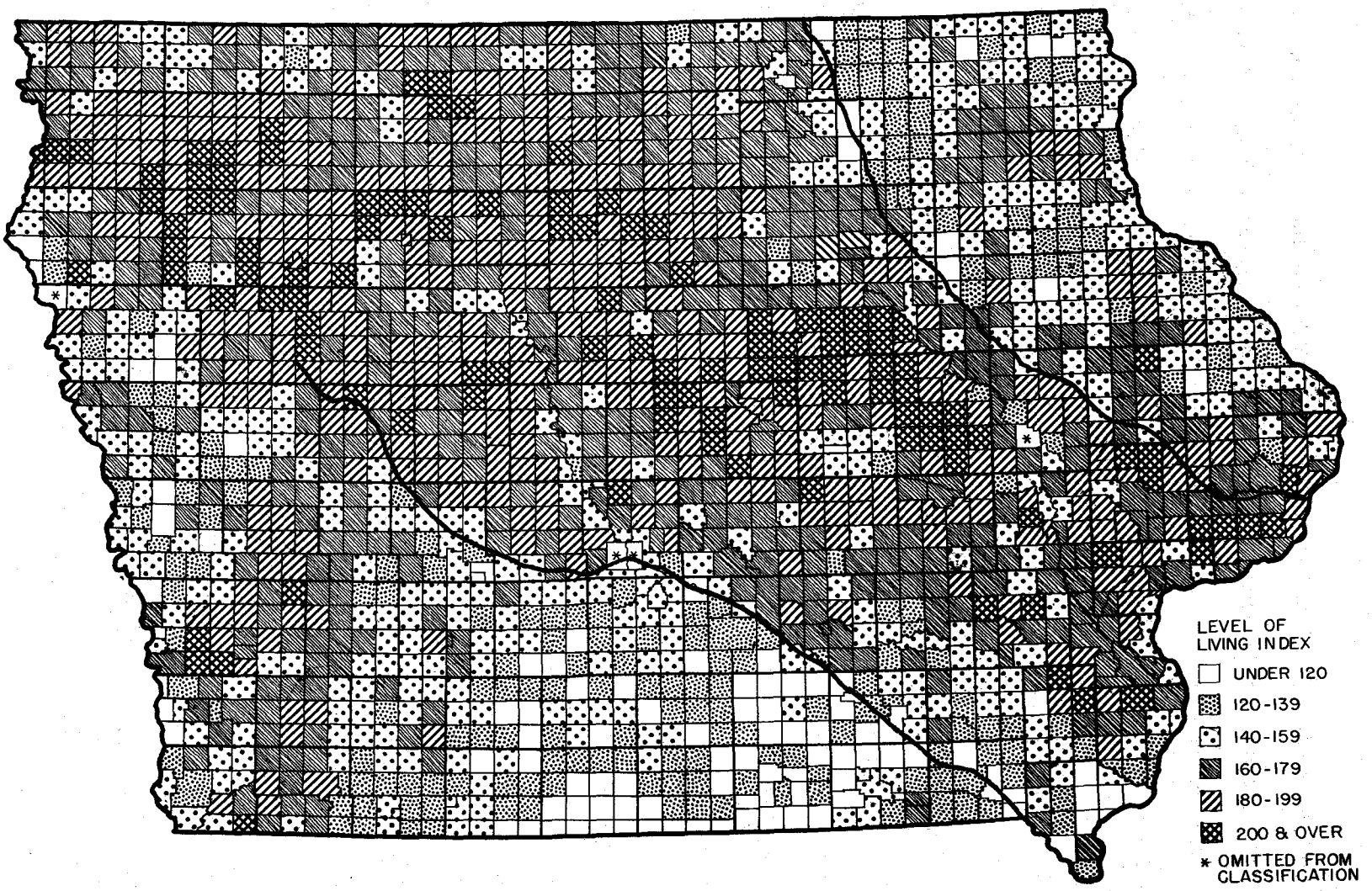

Fig. 2. Farm family level of living by townships, as bounded by the Wapsipinicon river and the Des Moines and the Middle Raccoon rivers, Iowa.

family level of living index intervals is given in Table 1 and shown in Figure 3.

Counties with the lowest ranges between level of living index intervals were located mainly in southern Iowa; those by the highest ranges between intervals in west, northwest Iowa. Only seven counties had ranges of one interval; 35 of two intervals; 37 of three intervals; 16 of four intervals; and four of five intervals. Those counties which showed interval ranges of three often clustered in small groups throughout the state, as likewise did the more homogeneous counties with ranges of two intervals. While considerable homogeneity may have existed within a county, certain of the townships in that county may have been part of a rather heterogeneous area that cut across county lines; or some townships in an heterogeneous county may have been part of a homogeneous level of living area. For these reasons, townships appeared to more effectively discriminate between different living levels among the farm families of the state, and therefore were superior to county level of living indexes for the identification of homogeneous or heterogeneous level of living areas.

C. Variations in Levels of Living - Statistical

Wide variations in levels of living of farm families by townships in Iowa has been indicated. Grouped into level of living index intervals the following distribution of townships occurred.

Table 1. Iowa counties classified by range in township farm family level of living index intervals, 1945

Lowest level of living index interval	Highest level of living index interval						
	Under 120	120-139	140-159	160-179	180-199	200 and over	Total
Under 120	-	3	8	10	7	4	32
120-139		-	2	2	15	9	28
140-159			-	-	13	12	25
160-179				-	-	12	12
180-199					-	2	2
200 and over						-	-
Total	-	3	10	12	35	39	99

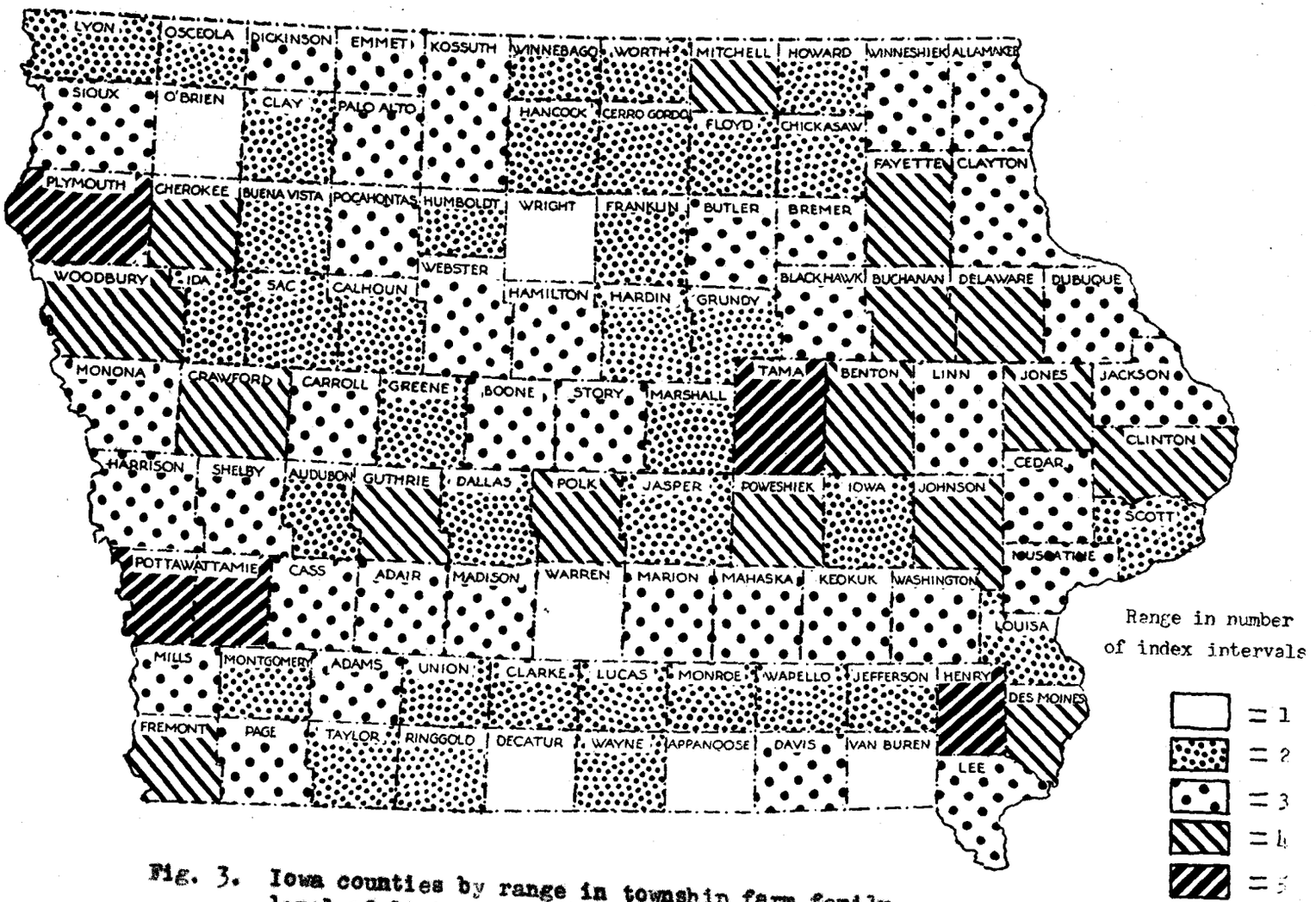

Fig. 3. Iowa counties by range in township farm family level of living index intervals.

Level of living index intervals

	Under 120	120-139	140-159	160-179	180-199	200 and over	Total
No. townships	106	201	346	436	386	111	1,586

There was a definite concentration within the higher intervals. To obtain a quintile, sextile or septile distribution the range in the lower intervals would have had to be enlarged and the range in the higher intervals decreased. Since the focus of this study was on uniform differences in levels of living, a uniform size interval was retained.

In the preparation of the graphic distribution of the 1,586 indexes, an interval of five index points was used to effect some smoothing in the curve. The curve, as did the distribution of the data in the table, showed skewness to the left. Both the mean and the median were less than the mode. In a normal distribution, the mean, median, and mode coincide.

Figure 5 provides another useful device for illustrating how a normal distribution of level of living indexes may be represented by a straight line instead of a curve. The extent to which the actual curve departed from the straight line indicated the degree of unevenness of the existing distribution of indexes: for example, the lower 20 percent of the townships accounted for only 15 percent of the aggregate of the indexes, while the upper 20 percent accounted for 24 percent of the aggregate. It may be hypothecated that the extent to

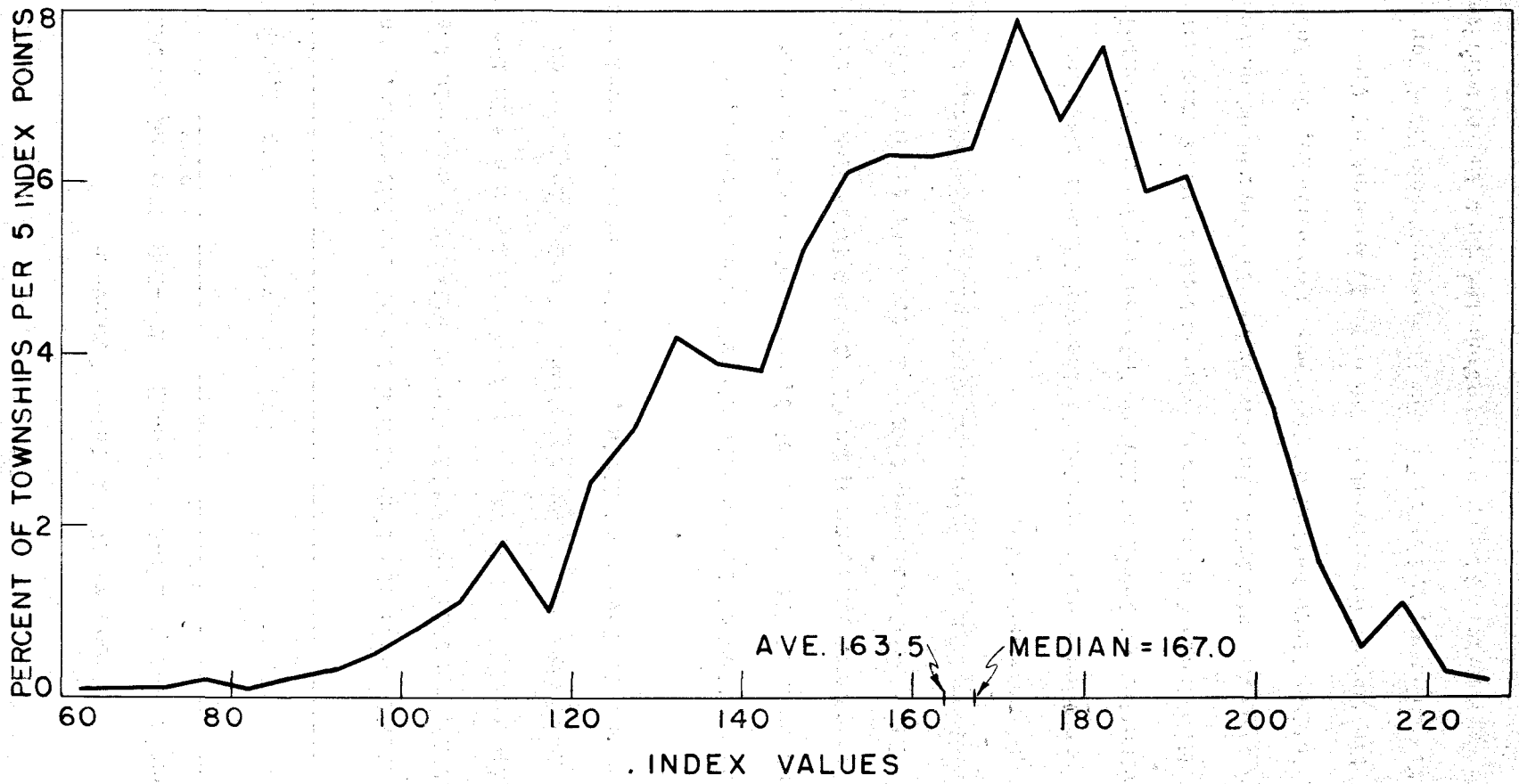

Fig. 4. Percentage distribution of townships by farm family level of living indexes.

which the curve deviated from the straight line, or as in Figure 4 the extent of skewness to the left, is an indicator of a similar type of distribution of the physical, economic and social variables that condition the level of living of Iowa families. That is, assuming a normal distribution of each of the variables which condition level of living, a straight line distribution of the level of living indexes could be expected.

Table 2. Cumulative distribution of the total of level of living indexes by percentage distribution of townships

Percent of townships	Percent aggregate index is of total aggregate index
10	6.8
20	15.0
30	23.9
40	33.3
50	43.3
60	53.7
70	64.5
80	75.7
90	87.5
100	100.0

D. Change in Levels of Living, 1940-1945

Time series data by townships covering a large number of years would make possible an analysis of dynamics of level of living. Data on change in level of living for this study was limited to that for Iowa counties for the period 1940 to 1945.[1] During the five year

[1] As of this writing, no other indexes of comparable nature are available by counties for any other years.

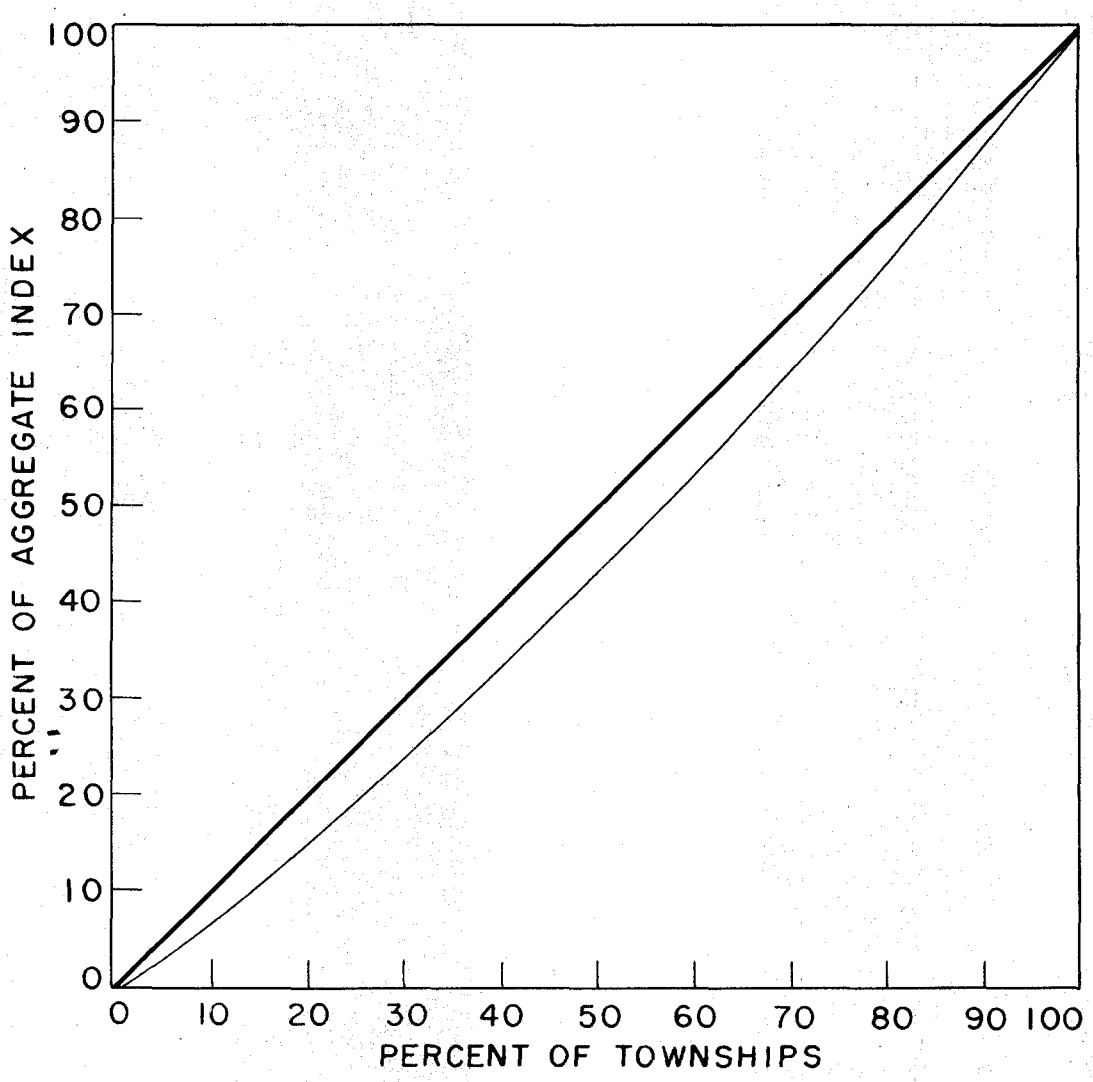

Fig. 5. Cumulative distribution of the total of level of living indexes by percentage distribution of townships.

period, farm families of Iowa experienced a 22 percent increase in level of living. All counties in the United States showed an average increase of 25 percent. By counties the percentage increases in Iowa ranged from 11 to 39 percent. Despite the range in percentage improvement, area-wide percentage increases tended to show considerable uniformity throughout the state. This suggests that counties and areas now low in comparison with other counties and areas of the state may be expected to continue that same relative positional relationship into the future. This hypothesis will be supported even more if indexes covering a larger number of years show the same positional relationship between the high and low counties and areas. Assuming that this is the case, marked adjustments of population to resources must take place in the low counties and areas to effectively raise the families' level of living, or a significant change must be made in the economy of the counties or areas.

Table 3 shows the numerical distribution of counties by size of increase in level of living index over the five year period. Within each numerical increase group, a percentage distribution of counties is shown to indicate the percentage increase the 1945 index represents of the 1940 index. In general, the counties gaining least numerically, gained least percentage-wise. The counties gaining most numerically gained most percentage-wise.

The following observations may be made from Figure 6 showing the distribution of counties by farm family level of living for 1940 and for 1945: (1) improvement in level of living was indicated by the

shift to the right of the curve for 1945 from that of 1940; (2) and more important, the range between low and high counties in 1945 increased as compared with 1940. The ranges were 91 and 79, respectively. This again indicated that some of the low counties were not

Table 3. Counties classified by numerical and percentage increase in farm family level of living indexes, 1940 to 1945

Increase in level of living index	Number of counties by percentage increase in level of living index						Average percentage increase
	Under 20	20-24	25-29	30-34	35-39	Total	
Under 20	10	-	-	-	-	10	5.5
20 - 24	5	5	-	-	-	10	18.1
25 - 29	11	13	1	-	-	25	20.1
30 - 34	3	21	13	1	-	38	23.3
35 - 39	-	2	9	1	1	13	27.2
40 and over	-	-	-	3	-	3	31.7
Total	29	41	23	5	1	99	22.0

showing a rate of increase in level of living commensurate with the rates shown by the high counties. The increase in range shown for the five year period although not large, if continued accordingly over a longer period of time, would increase heterogeneity in level of living of farm families.

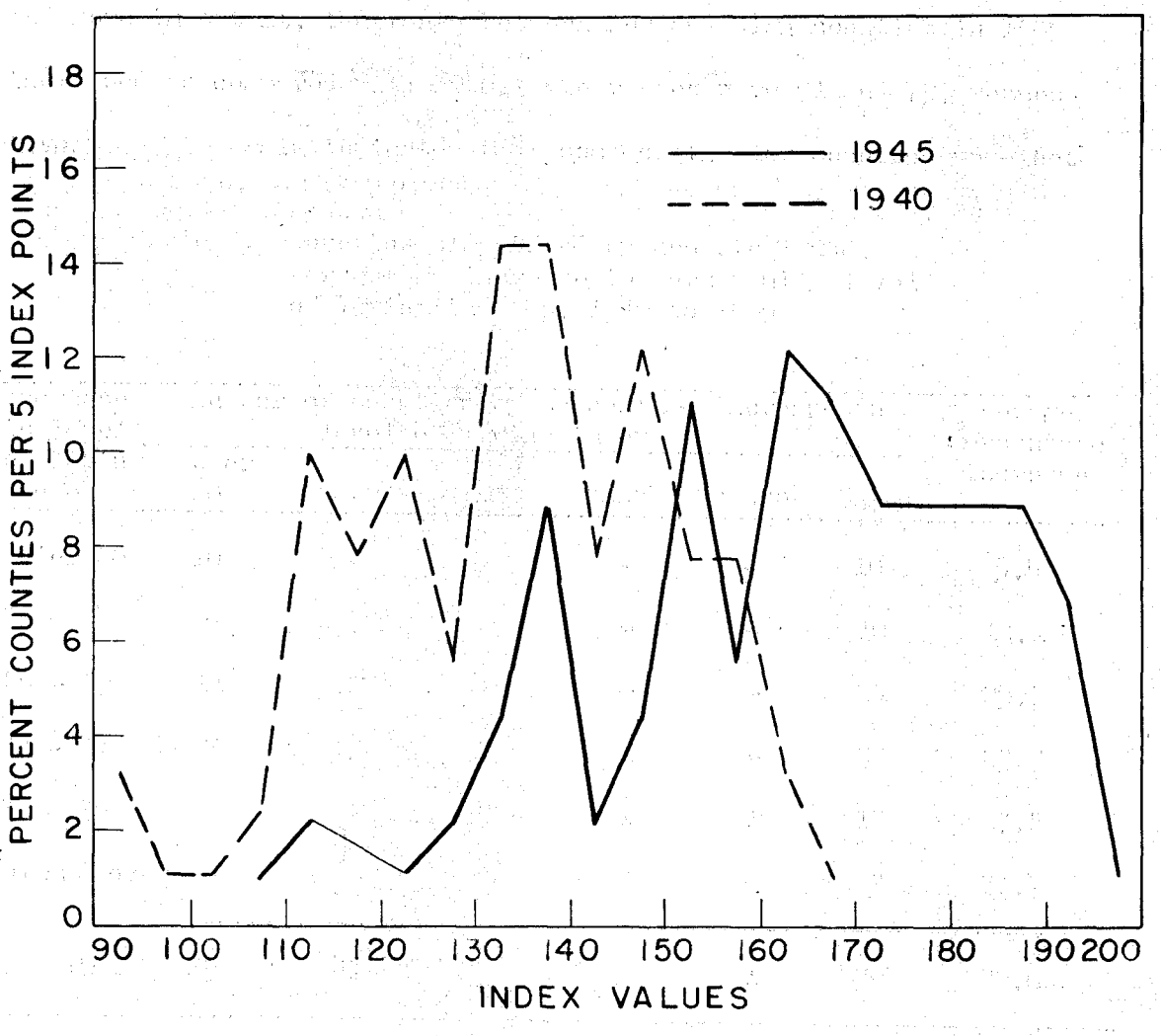

Fig. 6. Percentage distribution of counties by farm family level of living indexes, 1940 and 1945.

E. Relationship of Level of Living to Selected Social and Economic Variables

Much of the evidence presented thus far emphasized the extreme variability of level of living in a state normally thought of as relatively uniform and high in the well-being of the families. Such a viewpoint has resulted from excluding exceptions from view and from dealing mainly in large aggregates with measures of central tendency, with little attention given to evidences of dispersion. The wide variations suggested that families living in areas represented by the two extremes faced widely different problems and decisions on how to allocate their income and resources between those for family living and for farm operating expenses. Families in townships at the lower end of the index array obviously lacked one, two, three and even part or possibly all of the fourth item in the index. At the upper end of the array, families possessed nearly all, or all, of the items. Clearly, the families without electricity also lacked the labor saving and convenience type of equipment associated with electricity. The families without a telephone or an automobile or both were limited in communication facilities and quite probably were not in touch with a wide social universe. Families with a low income were faced with less flexibility in decision making with respect to allocation of income between farm operating and family living expenses. Certain phases of family living probably were curtailed such as health services, recreation, luxury

goods, and formal organization participation.

Since level of living indexes can be classified and the variations isolated, examination of the associational relationship of level of living to a selected group of variables is pertinent. No single variable, but several in interaction account for the differences in the level of living of a group of families. First, the isolation and measurement of the effect or associational relationship of certain of the available variables on level of living will be undertaken here.

The impact of a variable on the level of living of a group of families and its relationship to other variables may very well differ in time and place. That is, causation or association must not be interpreted too narrowly. For example, given low crop productivity, a group of families may be able to continue a high level of living due to finding new sources of income.

First approximations of the relative importance of the 12 variables used in computation of association with level of living were provided by simple variable-by-variable correlation analysis.[1]

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[1] In much of the analysis in the remainder of this study, the statistical treatment was that usually applied to samples of populations. The rationale for using such treatment on the total population is that the population was considered as one obtained from drawing level of living index numbers randomly from an infinite population. That is, the differences inherent in the levels of living throughout the state as indicated by the "F" tests were attributed to factors other than those brought about by sampling fluctuations.

Simple correlations of the independent variables with farm family level of living in order of size of correlation are shown below. Coefficients followed by a double asterisk (**) were significant at the one percent probability level.

Independent variable		Correlation coefficient
x_6	Crop productivity	.78**
x_{12}	Value of land and buildings	.75**
x_4	Mechanization index	.61**
x_{11}	Value of implements and machinery	.53**
x_5	Corn yield	.50**
x_2	Percent tenancy	.44**
x_{10}	Percent foreign born or of mixed parentage	.38**
x_9	Township participation rating score	.25**
x_7	Percent 1940 population is of the 1900 population	.20**
x_1	Size of farm	.11**
x_3	Number of farm persons per 100 acres	.08**
X_8	Percent rural farm population	-.05

The correlations as a whole show the degree to which two variates, here level of living paired with each other variate, kept in step as they changed. Plotting of the data indicated a linear relationship between level of living and each of the other variables. Crop productivity when correlated with level of living showed a high coefficient. This was followed by value of land and buildings, the mechanization index, value of implements and machinery and corn yield,

all with correlation coefficients of .50 or above. Other variables showed correlation coefficients of smaller magnitude.

The correlation coefficient of .44 of level of living with percent tenancy is of interest, since it indicates a propensity to greater tenancy in the higher land value and more productive areas of the state.

The association of level of living with percent foreign born or of mixed parentage is also of interest. This may have been the result of the general pattern followed during the state's settlement period by those of foreign birth or of mixed parentage. Generally, the areas settled by those of foreign birth or of mixed parentage were ones which showed the higher levels of living.

The correlation coefficient of .25 of the township participation rating score with level of living was to be expected. Mangus and Cottam made a similar finding in a study of levels of living and social participation in Ohio.[1] While the participation score used in this study was based on limited information on participation of local people, their interest and use of local volunteer leaders in county extension work in 1938, it served as a partial criterion of the role of level of living in participation.

While percent 1940 population is of 1900 population showed a .20 correlation with level of living, population as referred to in this

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[1] Mangus and Cottam, op. cit.

variable included the total, and not farm population alone, to which the level of living indexes apply. However, such a correlation, or even higher, might have been expected, as indicated by the relative increases in total population in the more highly productive and higher level of living areas of the state compared to the less productive areas.

The correlation coefficients obtained between size of farm and number of persons per 100 acres of farm land and level of living were so small as to suggest little or no relationship of the two variables with level of living.

The percent rural farm population is of total population likewise showed practically no correlation with level of living. As a matter of fact, a somewhat higher negative correlation might have been expected. A large, proportionate rural population often is associated with a low level of living, while a small rural population, proportionately speaking, often is associated with a high level of living.

The limitations of the simple variable-by-variable analysis are apparent. Correlation coefficients (r) do not always give an indication of the relative importance of the variables, because the variables may have intercorrelation effects which are not ascertainable from the simple correlation coefficients.

For the analysis of relationships among the 12 independent variables (x_1, x_2 ... x_{12}) and the dependent variable level of living (y), a multiple regression was computed to determine the value of the

independent variables in predicting level of living. The regression equation was $y = a + b_1x_1 + b_2x_2 + \ldots + b_{12}x_{12}$. It was assumed (1) that the effects of the variables are additive; (2) the error (unexplained residual) is normally and independently distributed; and (3) the variance of the x's is equal for all y's.

The various beta coefficients in the multiple regression equation were determined by the method of least squares. The equation is as follows:

$$y = 57.585 + .0652x_1 - .4350x_2 - .1672x_3 + .2540x_4 + .4480x_5 + .6312x_6 + .1276x_7 + .1573x_8 + .0194x_9 + .0681x_{10} + .0032x_{11} - .0382x_{12}$$

where x_1 = size of farm

x_2 = percent tenancy

x_3 = number of farm persons per 100 acres

x_4 = mechanization index

x_5 = corn yield

x_6 = crop productivity

x_7 = percent 1940 population is of the 1900 population

x_8 = percent rural farm population

x_9 = township participation rating score

x_{10} = percent foreign born or of mixed parentage

x_{11} = value of implements and machinery

x_{12} = value of land and buildings

y = farm family level of living.

The multiple correlation coefficient (r) was .8497[1] and the corresponding coefficient of determination (R^2) was .7219, or about 72 percent of the variation in level of living was associated with the independent variables. The unaccounted for variability was expressed by the coefficient of non-determination (1-.7219 = .2781) i.e., the proportion of the squared variability in the level of living of farm families not explained by the 12 variables.

The next step was to assess one by one the unique contribution of each of the 12 variables when the effects of all except one were eliminated. This was done through the standard partial regression analysis. By partialing out 11 of 12 variables, it was possible to measure the existing relationship between level of living and any single variable playing upon it when the other 11 variables were held constant.

The standard partial regression coefficients (b') for the 12 independent variables and their corresponding (t) values are:

b'_1 = 0.065	t_1 = 3.5856**
b'_2 = -0.151	t_2 = 8.2065**
b'_3 = -0.029	t_3 = 1.5508
b'_4 = 0.041	t_4 = 1.4657
b'_5 = 0.100	t_5 = 4.9554**
b'_6 = 0.729	t_6 = 26.5912**
b'_7 = 0.152	t_7 = 9.6879**
b'_8 = 0.136	t_8 = 9.1544**
b'_9 = 0.125	t_9 = 8.8099**

[1] Significant at the 1 percent probability level.

b'_{10} = 0.034 t_{10} = 2.1062*

b'_{11} = 0.043 t_{11} = 2.3462*

b'_{12} = -0.044 t_{12} = 1.5855

The (t) values followed by a double asterisk (**) indicate the standard partial regression coefficients that were significant at the one percent probability level. Those followed by a single asterisk (*) were significant at the five percent probability level.

The (t) values were computed by dividing the standard partial regression coefficients (b') by their standard errors. Nine of the 12 variables showed a statistically significant or a highly significant association with level of living. The fact that the associations were significant from a statistical point of view may have little practical significance, especially when the magnitude of association was small. Actually, statistical significance reflects the stability of the association in question, answering only the first question of reliability, not the crucial question of degree of control. In general, the above standard partial regression coefficients indicated the relative importance of the variables in predicting level of living. Here the crop productivity index showed the highest rate of change in level of living for each unit change in itself. This was followed by percent 1940 population is of the 1900 population and by percent tenancy.

Consideration of associations and the explanations of the various levels of living, raised the question of interrelationships among the variables. These were computed and are presented in Table 4.

variables used in the multiple regression equation

6	7	8	9	10	11	12
Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Township participation rating score	Percent foreign born and mixed parentage	Value of implements and machinery per 100 acres	Value of land and buildings per acre
.10	-.13	.15	-.08	.02	-.24	-.10
.59	.11	.03	.09	.27	.26	.50
.08	.29	-.13	.04	.21	.28	.27
.73	.21	-.80	.26	.50	.63	.79
.54	.06	-.14	.24	.35	.49	.63
1.00	.29	.12	.16	.42	.50	.79
.29	1.00	-.22	.11	.19	.26	.27
.12	-.22	1.00	-.12	.01	-.09	-.09
.16	.11	-.12	1.00	.00	.22	.24
.42	.19	.01	.00	1.00	.32	.41
.50	.26	-.09	.22	.32	1.00	.61
.79	.27	-.09	.24	.41	.61	1.00

highly significant, d.f. = 1585.

The coefficients indicate the intercorrelations between the independent variables. If two independent variables are correlated with each other perfectly (r=1), then the use of either one or the other is justified in the analysis. Nothing will be gained from using both variables in the major regression equation. In this analysis none of the paired combinations showed a correlation of more than $\pm$ .80.

Of the 66 possible pairs of independent variables, only five showed non-significant correlation coefficients, while 14 pairs showed correlation coefficients of $\pm$ .50 or more. Size of farm, percent tenancy, and farm persons per 100 acres were found to be correlated significantly with all the other variables except one each. Percent rural farm population and township participation rating score correlated significantly with all the other variables except two each, while percent foreign born and of mixed parentage correlated significantly with all the other variables except three. Each of the variables showed a significant or highly significant correlation coefficient with all, or nearly all, of the other variables. Mechanization index, crop productivity, value of implements and machinery and value of land and buildings were correlated .50 or more with from four to six other variables.

While the above intercorrelation analysis pointed up the various significant correlation combinations among the independent variables used in this study, the significance of the (t) value computed for each

of the beta coefficients in the multiple regression equation determined the importance of each of the variables for predicting level of living.

On the basis of lack of significance as determined by the (t) values and other pertinent information, the following five variables were dropped from further consideration in this study: (1) number of persons per 100 acres (x_3); (2) mechanization index (x_4); (3) corn yield (x_5); (4) township participation rating score (x_9); and (5) percent foreign born and of mixed parentage (x_{10}). The first is inversely related to farm size, but, showing no significance, was dropped. The second, likewise showed no significance, and since it is reflected by the more inclusive variable value of implements and machinery, it was eliminated. Corn yield, while showing a highly significant value, may be considered a part of the more inclusive variable of crop productivity, hence was dropped. The township participation rating score, while showing a highly significant value, was considered too limited in its inclusiveness of organizational participation among farm families and the data of not recent enough origin for retention in this analysis. The percentage foreign born and of mixed parentage, while showing a significant value, was dropped from further analysis because of its date, (1930). It is assumed that more recent data would have been useful for analysis by areas. Its consideration up to this point helped to confirm the hypothesized relationship between level of living and ethnic configuration in Iowa. Logically, value of land and buildings, which

showed no statistical significance, should have been dropped from further consideration. The decision to retain it was premised on the practical consideration of widespread interest in this variable and its hypothecated relationship to level of living in areas smaller than that of a state, as will be considered particularly in Chapters VI and VII.

This drop-out procedure left seven independent variables for further use in this study.[1]

Having dropped five of the twelve variables from the regression equation, the equation was solved for the new beta coefficients. It became:

$$y = 82.7877 + .1318x_1 - .2499x_2 + .3744x_6 - .0034x_7 - .0191x_8 + .0095x_{11} + .2465x_{12}$$

where

x_1 = size of farm

x_2 = percent of tenancy

x_6 = crop productivity

x_7 = percent 1940 population is of the 1900 population

x_8 = percent rural farm population

x_{11} = value of implements and machinery

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[1] For reference to the precedent of dropping more than one non-significant variable at a time without a recomputation of the regression equation see Johnson, Palmer O. Statistical methods in research. New York, Prentice-Hall, Inc. 1949. p. 339. The dropping of three additional significant variables and retention of a non-significant variable was a decision of the author made after consultation and much discussion with researchers qualified to hypothecate the relationship of the variables retained with level of living on a small area basis.

x_{12} = value of land and buildings

y = farm family level of living.

The multiple correlation coefficient (R) was .8148[1]. This was only .0349 below that of .8497 computed for the 12 variables. The corresponding coefficient of determination (R^2) was .6639. In other words about 66 percent of the variation in level of living was associated with the independent variables. Statistically, the reduction in the multiple correlation coefficient through dropping five of the variables was found to be highly significant. Practically, however the usefulness of data which is old or which shows a fairly high correlation with other more inclusive variables is questioned. Their inclusion up to this point was principally for exploratory purposes.

As for the 12 variables, an assessment of the contribution of each of the seven variables through the standard partial regression analysis was done.

The standard partial regression coefficients (b') for the seven variables and their corresponding (t) values were as follows:

b'_1 = 0.153	t_1 = 9.07**
b'_2 =-0.101	t_2 = 5.18**
b'_6 = 0.471	t_6 =14.36**
b'_7 =-0.004	t_7 = 0.26
b'_8 =-0.018	t_8 = 1.09
b'_{11} = 0.146	t_{11} = 7.59**
b'_{12} = 0.328	t_{12} =10.52**

[1]Significant at the 1 percent probability level.

Five of the seven partial regression coefficients (as shown by **) were significant at the one percent probability level. Again crop productivity showed the highest rate of change in level of living for each unit change in itself. Value of land and buildings, while not showing any significance when previously used with 11 variables held constant, showed a statistically highly significant association. The three remaining variables showing highly significant association were size of farm, percent tenancy and value of implements and machinery. The two non-significant items were the two population variables. Despite their non-significance it was decided to retain these two variables for further analysis. This decision was predicated on the hypothesis that the importance of the variables will vary area by area as against their importance for the state as a whole.

While crop productivity and value of land and buildings showed up as relatively important for the state as a whole, farm size and value of implements and machinery were of relatively minor importance in association with level of living. Percent tenancy, percent 1940 population is of the 1900 population and percent rural farm population were of minor importance, but in a negative manner. In the simple correlation analysis, crop productivity and value of land and buildings when correlated with level of living also showed the highest coefficients. Value of implements and machinery was third highest.

In Table 5, the simple correlation coefficients (r) are examined for the seven variables. Except for the fewer variables used, Table 5 is identical with Table 4.

Table 5. Intercorrelations among the 7 variables used in the multiple regression equation

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.24	.10	-.13	.15	-.24	-.10
Percent farm land tenant operated	.24	1.00	.59	.11	.03	.26	.50
Crop productivity index	.10	.59	1.00	.29	.12	.50	.79
Percent 1940 population is of the 1900 population	-.13	.11	.29	1.00	-.22	.26	.27
Percent rural farm population	.15	.03	.12	-.22	1.00	-.09	-.09
Value of implements and machinery per 100 acres	-.24	.26	.50	.26	-.09	1.00	.61
Value of land and buildings per acre	-.10	.50	.79	.27	-.09	.61	1.00

Significant values are 0.06 and 0.07. Those of 0.08 and above are highly significant, d.f. = 1585.

The coefficients indicate the intercorrelation between the independent variables. Of the 21 possible pairs of independent variables, only one showed a non-significant correlation coefficient, and that was percent tenancy with percent rural farm population. Percent tenancy, crop productivity, value of implements and machinery, and value of land and buildings were correlated .50 or more with from two to three other variables. The first three of the four variables were found to correlate .50 or more with value of land and buildings. Percent tenancy, value of implements and machinery and value of land and buildings were found to correlate .50 or more with crop productivity.

F. Summary

While in a generalized sense, Iowa is considered a segment of a larger universe of similarities, wide variations in farm family level of living were found within its borders. Township indexes ranged from 60 to 228.

The use of township farm family level of living indexes made possible identification of: (1) variations within counties, and (2) similar levels of living that cut across county lines.

The lowest one-fifth of the township indexes were located in the south, west and northeast parts of the state, the highest one-fifth extended from southeast to northwest Iowa. The middle one-fifth of the townships represented by the index level of 140-159

appeared to have the least propensity for contiguity.

Levels of living were found to vary widely, often within small areas. Ranges of indexes from the lowest to the highest level of living index intervals were found in four of the counties. Only seven counties had township indexes varying as little as one interval.

Between 1940 and 1945, the farm family level of living index increased 22 percent with county increases ranging from 11 to 39 percent. The numerical increase in index points generally favored the counties and areas in which families already had a relatively high level of living.

Simple correlations between a selected group of variables and level of living showed the following coefficients: crop productivity .78; value of land and buildings .75; value of implements and machinery .53; percent tenancy .44; percent 1940 population is of the 1900 population .20; size of farm .11; and, percent rural farm population -.05. As a group, the seven variables showed a multiple correlation coefficient of .8148, thus accounting for 66 percent of the variation in the township farm family level of living indexes. As indicated by its correlation coefficient, crop productivity accounted for most of the variation.

Standard partial regression analysis showed five of the seven variables to be statistically significant predictors of level of living. While the other two variables were non-significant, they were retained for use in analyses by soil association areas and by homogeneous and non-homogeneous areas.

The presentation generally has demonstrated the usefulness of the township indexes for showing variations in levels of living within the state and within counties and for identification of concentrations of various levels of living that cut across county lines. The sensitivity of the township indexes to changes in physical, economic and social factors affecting family living makes the use of a unit as small as a township highly desirable for identification and analysis of areal variation in levels of living.

V. FARM FAMILY LEVEL OF LIVING BY TYPE OF FARMING AREAS

A. Introduction

Proceeding from an overall analysis of farm family levels of living in Iowa, the next step was to determine how well the five type of farming areas (Western Meat, North Central Grain, Northeast Dairy, East Central Meat and Southern Pasture) differentiated farm family levels of living and whether or not such areas may be considered as useful bases for more intensive analyses of levels of living.

B. Type of Farming Area Concept

Type of farming areas constitute meaningful areal universes, whose delineation is the end product of years of production-economic study. They are especially significant as rural universes. It is assumed that within each the ways of making a living are roughly uniform and that the production of the same product, or combination of products, peculiar to each area results in a certain amount of common activity and broadly similar interests, values and attitudes.

Differences among type of farming areas have arisen in response to a combination of physical, economic and historical factors. The

way the farm work is done in the various areas gives each a distinguishing characteristic. Farm tenants are much more prevalent in some than in others. Certain areas are more highly mechanized than others, and require appropriate machinery for carrying on the prevailing enterprises. Work cycles differ, for example, from the cash grain farm to the dairy farm, the latter requiring regular daily work throughout the year. Types of special interest groups differ from area to area, and are associated closely with the prevailing agricultural enterprises. This points up only some of the whole complex of production-economic-cultural activities which broadly serve to characterize type of farm areas. The variations would imply significant differences in levels of living from area to area.

C. Characteristics of Type of Farming Areas

The Western Meat area[1] extends north and south along the western border of the state, Figure 7. Populated somewhat later than eastern and southern Iowa, small farms never became a very great problem. For the past 50 years the number of people on farms has been decreasing. The area specializes in hogs and cattle feeding though still having a diversified farming system. Considerable cash corn is sold, especially from river bottom farms.

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[1] The description of the individual areas is based largely on the publication: Iowa Agricultural Extension Service, Program Planning Committee, op. cit.

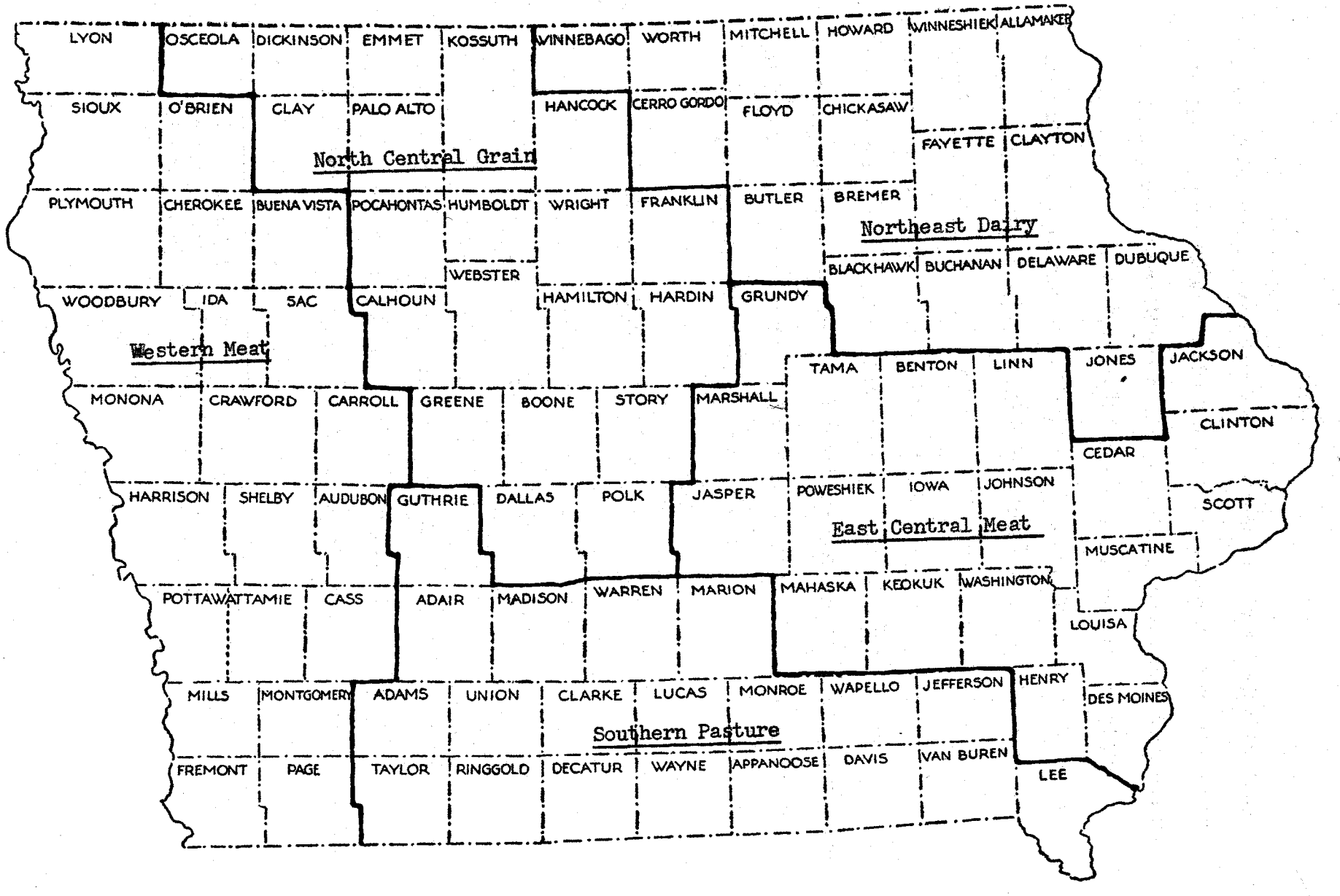

Fig. 7. Type of farming areas

The North Central Grain area was about the latest in Iowa to be settled. The level to undulating prairie derived soils could not be readily tilled until much of the land had been drained, involving considerable investment in land preparation. Many immigrants including Scandinavians, Germans, English and Irish settled in this area. The farm population never became large relative to the resources. The area provides much corn and oats, and more recently soybeans, for outshipment. However, livestock, especially hogs, bring in a larger income than grain, and both cattle and poultry are important. More farms are operated by tenants than in any other area.

The Southern Pasture area was one of the earliest settled in the state. Most of the residents are descendants of old American stock. The peak population was reached well before 1900 and has been declining since, with the surplus population tending to migrate at an early age. A large number of operators are older farmers. The number of people on farms has decreased fully a third since 1890. The area has the largest proportion of land in permanent pasture, although considerable grain is raised. Livestock enterprises predominate, with cattle and sheep being relatively important. Part-time farming is common throughout the area.

The Northeast Dairy area includes the more rolling counties of that part of the state. The area was settled relatively early, drawing heavily of foreign immigrants, mainly German, Scandinavian, English and Irish. In spite of declining over the past 50 years, farm population density is still about as large as in 1900, and is greater

than that of other areas in the state. The area more properly might be called hog-dairy, since hogs are its largest single source of income. However, dairying is more important here than elsewhere in the state. Poultry is an important enterprise.

The Eastern Livestock area was populated early in the history of Iowa, much of it by 1860. Germans comprised about half of the total foreign born immigrants, though a number of communities were made up of Scandinavians, Irish, English and Bohemians. In making the adjustment to resources, population shifts have resulted in a decline of about a third in the farm population in the last 50 years. The area is the most intensive in hogs, although cattle feeding and dairying are both important. Grain acreage is fairly large and yields are high, but nearly all grain produced is fed locally. A larger proportion of farmers than in any other area report off-farm work.

Many similarities and dissimilarities exist among the areas. How these may affect farm family levels of living, and whether or not the areas are important considerations in level of living analyses, will be treated next.

D. Analysis of Data by Type of Farming Areas

Type of farming area delineations follow county lines, therefore, county level of living indexes, rather than township level of living indexes, are the data used. The five areas range in size from 18 to

21 counties each. The mean level of living in 1945 ranged from 133 to 179. Five years earlier, the range was from 111 to 149. During the five year period an increase of eight index points occurred in the range from low to high. Inasmuch as county data represent larger aggregates than township data, differences and variations between and among county data usually will not be as great as that of townships.

A measure of average variation in levels of living is the standard deviation. Over the five year period the standard deviation increased from 17.1 to 20.6. Four of the five areas had higher standard deviations in 1945 than in 1940. Only the East Central Meat showed a decline.

North Central Cash Grain with a standard deviation of 8.6 indicated the greatest homogeneity of county level of living indexes; while Western Meat with a standard deviation of 16.3, or nearly double that of the first area, the greatest heterogeneity. Both areas maintained their homogeneity and heterogeneity, respectively, over the five year period. Southern Pasture showed the greatest numerical, as well as proportional, increases in standard deviation between 1940 and 1945. This would seem to confirm that during the five year period heterogeneity in levels of living of farm families in this area increased.

Considering only standard deviation for 1945, homogeneity to heterogeneity by areas proceeded from North Central Grain, to East Central Meat, to Northeast Dairy, to Southern Pasture and to Western Meat.

Table 6. Means and standard deviations of farm family level of living indexes for counties by type of farming areas, Iowa, 1940 and 1945

	Type of farming areas					
	Western Meat	North Central Grain	North-east Dairy	East Central Meat	Southern Pasture	All areas
No. counties	21	20	18	20	20	99
Mean (1945)	168.9	178.6	158.9	172.0	133.0	162.4
Mean (1940)	135.9	145.8	128.7	143.7	110.7	133.1
Standard deviation (1945)	16.3	8.6	12.8	11.6	13.5	20.6
Standard deviation (1940)	15.5	8.0	10.7	11.9	9.8	17.1

To more adequately determine the usefulness or non-usefulness of the type of farming areas as bases for the study of level of living, the total of the five areas and all possible two-area combinations were subjected to analysis of variance, Table 7. It was hypothesized that significant differences in level of living were to be found among and between the areas. Differences in means suggested that possibility. However, means do not give any indication of the variance of individual county indexes around the means within the type of farming

areas or with the variance of the area means around the general mean of the ungrouped data.

For the total a highly significant difference was indicated. Of the ten possible two-area combinations, five showed a highly significant difference, three showed a significant difference and two showed

Table 7. The "F" results of the analysis of variance of level of living indexes by counties for all two-area combinations of type of farming areas, and for total

	Type of farming areas				
	North Central Grain	North-east Dairy	East Central Meat	Southern Pasture	Total
Western Meat	4.6*	5.2*	1.0	58.5**	
North Central Grain		34.3*	2.6	161.8**	
Northeast Dairy			14.6**	36.0**	
East Central Meat				99.6**	
Total					13.6**

*Significant at the 5 percent probability level.
**Significant at the 1 percent probability level.

no difference. The hypothesis of significant difference was confirmed for eight of the ten two-area combinations. That a highly significant difference, or at least a significant difference, was not found for all ten two-area combinations suggests the inadvisability of using type of farming areas as bases for further analysis of levels of living. More important was the fact that four of the five highly significant

differences were between Southern Pasture and the other four areas. Northeast Dairy and East Central Meat represented the fifth two-area combination showing a highly significant difference in levels of living.

E. Summary

From the above results, it was not believed that much additional information over that for the state as a whole could be gained in pursuing more intensive analysis of levels of living on the type of farming area basis. While a number of dissimilarities in agricultural production activities and in some of the population characteristics exist, those differences were not strongly indicated for levels of living except in comparisons of Southern Pasture with the other four areas.

Rejection of type of farming areas as useful for our purposes does not mean that such areas are not useful for analysis of other types of data. Two questions may be raised however. Do each of the areas have a central core around which the much larger area is built? Are those cores sufficiently unique to adequately differentiate levels of living? Considerable additional research will be needed to provide the answers.

VI. FARM FAMILY LEVEL OF LIVING BY PRINCIPAL SOIL ASSOCIATION AREAS

A. Introduction

The analyses in Chapters IV and V were concerned principally with the overall view of level of living of farm families in Iowa. Type of farming areas provided only generalized differentiations in levels of living. The analysis in this chapter deals with determining how well adapted the principal soil association areas of the state are for differentiating levels of living. Such areas are the product of many years of mapping and classification of soil types by soil scientists.

The magnitude of the crop productivity and level of living association was indicated in Chapter IV. Inasmuch as crop productivity is influenced partially by the properties of the soil, it was hypothecated that soil areas differentiate levels of living and related factors with considerable reliability. With this brief background, the analysis of the data is presented and discussed.

B. Soil Association Area Concept

A soil association area represents,

> A repeating pattern of soil types rather than soil uniformity . . . . Each soil association has an arrangement of soil types and other features, principally topography, which gives it a characteristic

> landscape . . . therefore, is simply a group of soil types which are most commonly found in a given area.[1]

In a further elaboration on their concept of soil association area, Ricken and Smith have said,

> The soils of each soil association area is the resultant of the various factors that have influenced the formation of the various soil types. These factors are as follows: (1) Parent or geological material, (2) natural vegetation and other biological factors, (3) topography or lay-of-the-land, (4) climate, (5) length of time that the soils have weathered.
>
> All of these factors need to be considered in interpreting and explaining the different properties of the various soil types.[2]

In order to further clarify the soil association area concept, it is necessary to distinguish between the two major types of land classification--physical and use.

> Physical classification groups soils according to their natural qualities, while use classifications include, in addition to these physical factors, all economic forces which condition the use man makes of land. When land is classified on the basis of physical or inherent characteristics alone, certain natural qualities are looked for such as topography, soil characteristics, vegetative cover, rainfall, chemical composition, position, and similar physical factors.[3]

Renne listed three principal types of land classification within the use classification: "(1) present use, (2) use capabilities, and (3) recommended use."[4] Thus, he said that in addition

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[1] Riecken, F. F. and Smith, Guy D. op. cit., p. 2.

[2] Ibid., p. 3.

[3] Renne, Roland R. Land economics. N. Y., Harper and Bros., 1947. p. 40.

[4] Ibid., p. 42.

to natural qualities of the land,

> . . . economic considerations such as market accessibility; size and type of operating unit; size, distribution and composition of the population; location of roads, schools, power lines, stores, factories, and mines; location, size and type of properties; type of ownership; economic outlook and price prospects; transport facilities; costs of production; and related economic items must be taken into consideration in determining uses to which the land can be most efficiently put.[1]

While the prevailing level of living of people on the land was implied, the implicitness was not clear in the foregoing listing of considerations. The writer is not aware of any instances where level of living has been included as one of the components on any wide scale land use classification. This is not surprising, because areal indexes of level of living are relatively new and in previously published form have been confined to units no smaller than a county. A large unit is not practicable for most land use classification purposes.

C. Principal Soil Association Areas in Iowa

The eight principal soil association areas used in this analysis are shown in Figure 8.[2]

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[1] Ibid., p. 42.

[2] See Riecken and Smith, op. cit., opposite p. 2. The principal soil association area boundaries in Figure 8 represent slight modification of those shown in the above publication. The modifications were concurred in by the authors and F. L. Thompson of the Iowa State College Agronomy Department and A. R. Aandahl formerly of that department. The modifications were effected insofar as possible by including highly similar soil types together in each area.

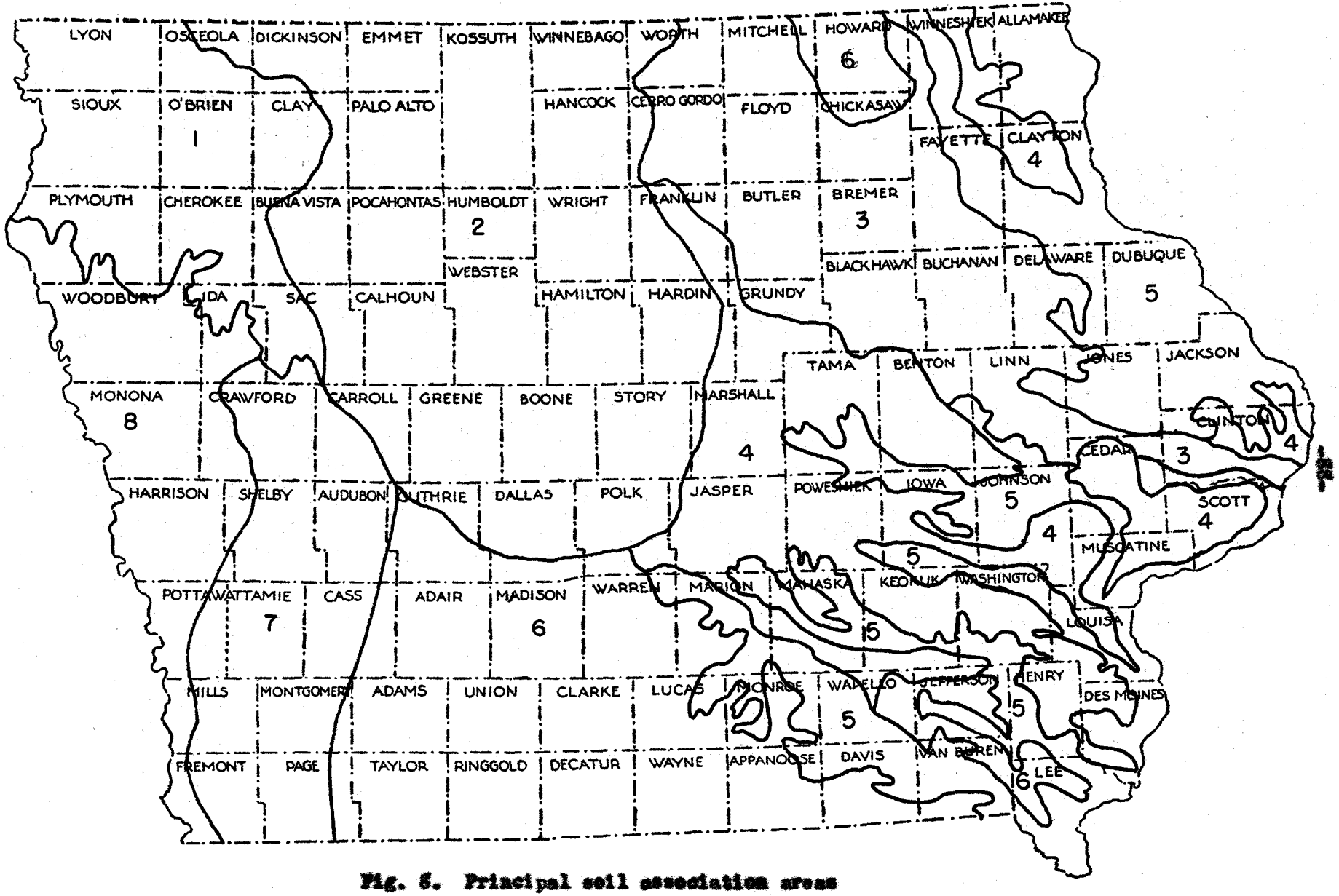

Fig. 6. Principal soil association areas

While solid lines have been used in this figure to differentiate the soil association areas one from another, the transition from one association to another in some instances is gradational, as from areas 3 to 4, from 6 to 7 and from 7 to 8. Changes between other areas are more abrupt and definitive. Iowa's major surface deposits originated primarily from deposition by ice or by wind in the geologic past. Associated with these deposits is material which has been laid down by the streams along their banks in recent times, or in the more or less distant past. Glacial deposits covered all or nearly all of the state. Several different ice sheets invaded the state at different times but not all covered the state. The action of the more recent glaciers accounts to a high degree for the large areas of relatively level land in much of Iowa. The rougher areas represent what is known as a mature topography.[1] As shown in Figure 8, in the west two-thirds of the state the soil contours or delineation lines are fairly regular. Each of the principal soil associations covers considerable area. For a listing of soil types within each area, see Table 9. In the east one-third of the state, considerable dissection is evident, much of it due to the action of rivers. If the assumption is

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[1] Information in this paragraph largely adapted from Firkins, B. J. and Brown, P. E. The geology of Iowa. In Brown, P. E. Soils of Iowa. Ia. Agr. Exp. Sta. Special Report 3. 1936. p. 6-7.

correct that soil areas differentiate levels of living, then in areas of considerable dissection wide variations in levels of living may be expected.

D. Measure of Soil Productivity

Crop productivity is the usual criterion, for lack of any other more satisfactory and easily used measure, for estimating the productivity of a soil. It may be considered as a measure of the productivity of a stated soil under a given state of cultural arts. The extent to which a given state of cultural arts mirrors the potential of a soil cannot be determined without consideration of a whole complex of physical, social and economic factors affecting production. For example, the nature of the soil pattern influences the management, and thus has an indirect effect on crop yields. The interaction between soil patterns and management exists partly because the tillage operations are conditioned by the soil patterns. Climatic fluctuations affect soil productivity. Similarly, the level of production of a soil does not remain constant even when the system of management remains the same.

In an evaluation of methods involving soil productivity data, Aandahl pointed out that, "All methods involve yield measurements or estimates and these may be either relative or absolute."[1] The

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[1] Aandahl, Andrew R. Estimation of soil productivity in relation to land values and farm management. Unpublished Ph.D. thesis. Ames, Iowa, Iowa State College Library. 1949. p. 12.

crop productivity index used in this study covered a five year period. Thus, annual fluctuations were minimized and the usefulness of the index as an indicator of soil productivity increased.

E. Relationship of Level of Living to Selected Social and Economic Variables

This part of the study is concerned: (1) with empirically determining how well adapted the principal soil association areas are for differentiating farm family levels of living; and (2) with testing the associational relationships between and among the variables selected for analysis with level of living in the eight soil association areas. Little or no research has been conducted on attempting to predict level of living from selected variables by soil area. Therefore, little is known about the relationships of those variables with level of living or how they differ in their relationships to each other. Preliminary to the more critical analysis, data pertaining to the size of the areas and means of the variables by areas will be examined.

The areas ranged in size from 103 to 333 townships, Table 8. Three of the eight areas 1, 2, and 4 showed relatively high and nearly identical means in level of living, 181 to 184. The first two are characterized by cash grain farming, the third by livestock raising and dairying. Mean levels of living in the other areas ranged from 134 to 170.

Average size of farm varied by 31.5 acres from low to high area. Percent tenancy varied from 39 to 61 percent, in general being lowest in the soil association areas characterized by considerable diversification in farming. Areas of prevailing cash grain farming tended to show higher tenancy rates.

The crop productivity index varied widely from area to area, ranging from a low of 54 to a high of 129, in general being highest in those areas predominating in cash grain farming.

Percent 1940 population is of the 1900 population, as reflected by the average of the percentages for the individual townships, indicated that in six of the eight areas declines were shown. Only areas 1 and 2 showed generally uniform population increases.

Percent rural farm population showed considerable uniformity from area to area. The high unweighted mean of the township percentages in each of the areas actually was an indication of the large number of townships entirely, or almost entirely, made up of a rural farm population.

Value of implements and machinery per 100 acres showed considerable variation from area to area, ranging from $676 to $1,314. In general, those soil association areas in which cash grain and dairy farming predominate showed the higher investments in operational equipment.

Value of land and buildings tended to correspond to the same general distribution as that of value of implements and machinery. Areas 1 and 2 showed values more than double that of the lowest area, 6.

Table 8. Number of townships and means of farm family level of living indexes and of seven selected variables by principal soil association areas, Iowa

	Soil association areas								
	1	2	3	4	5	6	7	8	All areas
Number of townships	127	333	180	215	254	253	121	103	1586
Farm family level of living index[a]	183.6	180.8	162.8	181.1	149.1	133.8	170.4	147.4	163.5
Size of farm, acres[a]	195.8	184.2	165.9	169.6	169.7	180.6	187.2	197.4	179.3
Percent tenancy[a]	61.1	58.1	52.4	51.7	39.0	45.0	54.0	55.8	51.2
Crop productivity index[a]	125.3	128.8	88.8	106.5	63.8	54.0	111.2	102.5	95.6
Percent 1940 population is of the 1900 population[a]	102.3	104.7	99.1	88.1	82.4	78.6	81.3	90.3	91.2
Percent rural farm population[a]	74.1	71.6	71.6	72.1	70.8	76.1	77.1	72.6	73.0
Value of implements and machinery per 100 acres[a]	$1172	1314	1205	1272	930	676	1002	944	1084
Value of land and buildings per acre[a]	$ 132	135	97	123	78	65	107	89	103

[a]Data presented represents the unweighted means of township means or township percentages.

The mean values shown in the table indicated the greatest proportional variability in crop productivity, value of implements and machinery and value of land and buildings. All three showed high values in certain areas and low values in others.

Figure 9 shows the principal soil association areas superimposed upon a map of farm family level of living by townships. This groups the townships into areas in which relatively homogeneous soil types prevail. A township was included in a particular soil association area on the basis of whether or not more than one-half of the township was located within it. Because of the small size of a township, it was well suited to this type of arbitrary inclusion or exclusion.

It can be assumed from the foregoing, and particularly from inspection of Figure 9, that in terms of levels of living most of the soil association areas differed one from another. While wide ranges in levels of living were found in each of the areas, the clustering of most of the indexes within rather narrow limits was evident. The standard deviations ranged from 15.4 to 24.5 for the eight areas. The standard deviation for the state was 27.2. Area 5, which is wholly within the east central and southeast part of the state, showed the greatest heterogeneity in township level of living indexes. Area 2, characterized by a relatively high soil fertility and level land, showed considerable homogeneity. In terms of extremes in range from low to high index, area 1 showed

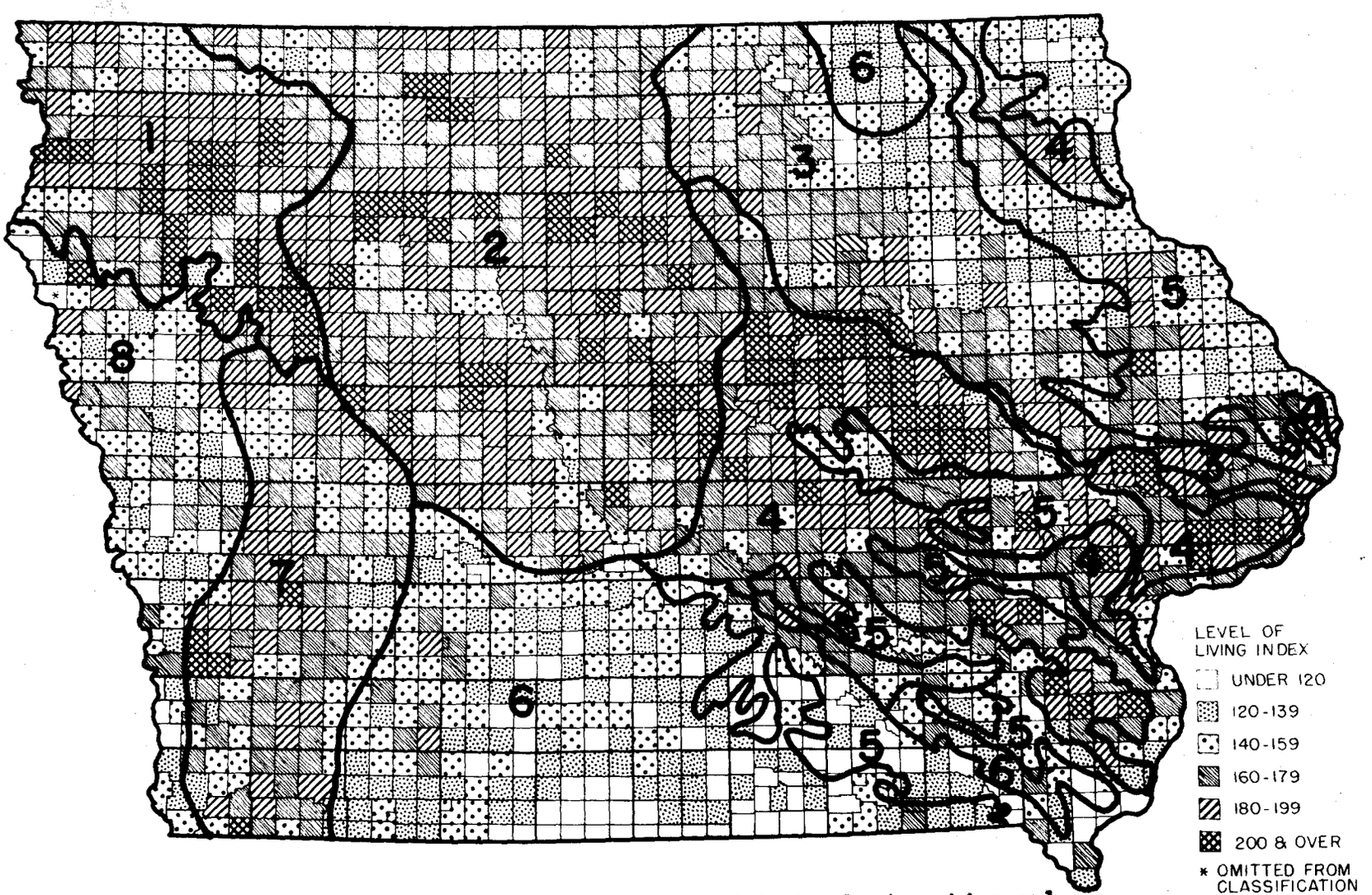

Fig. 9. Farm family level of living by townships and principal soil association areas

the least range 143-225, while area 5 showed the greatest range, 88-215.

Considering only standard deviation, homogeneity to heterogeneity in level of living proceeded area by area in the following manner, area 2, 7, 4, 6, 3, 1, 8 and 5. In general, this progression was from level to increasingly broken and hilly terrain, or from the least to the most mature areas of the state.

To further determine the variability of level of living of farm operator families between and among the various soil areas, the total and all possible two-area combinations were subjected to analysis of variance. Differences in most of the means suggested the hypothesis that significant differences in levels of living were to be found among and between the areas. The F's for the 28 two-area combinations are given in Table 10.

A highly significant difference for total and for 24 of the 28 possible two-area combinations was found. No significant difference was found between the following two-area combinations: 1 and 2, 2 and 4, 1 and 4, and 5 and 8. Areas 1, 2 and 4 are those located in the least mature, while 5 and 8 are located in the more mature areas of the state. In general, the hypothesis that soil association areas do differentiate between farm family levels of living was supported.

The discussion thus far has dealt with areal variations in levels of living. The next step was to analyze by areas the associational relationships of level of living to the selected group of seven variables. First, simple correlations between each of the independent

Table 9. Soil types, number of townships, means, ranges and standard deviations of farm family level of living indexes by principal soil association areas, Iowa, 1945

Area	Soil types	Number of town-ships	Mean of level of living indexes	Range in level of living indexes	Standard deviation of level of living indexes
1	Galva, Marcus, Moody, Primghar, Sac	127	183.6	143-225	22.1
2	Clarion, Storden, Webster	333	180.8	123-228	15.4
3	Carrington, Clyde	180	162.8	94-215	21.1
4	Downs, Mahaska, Muscatine, Taintor, Tama	215	181.1	103-222	20.6
5	Bottom Soils, Dubuque, Fayette, Lindley, Stony Lands	254	149.1	88-215	24.5
6	Carrington, Clyde, Edina, Grundy, Haig, Lindley, Seymour, Sharpsburg, Shelby, Weller, Winterset	253	133.8	60-181	20.7
7	Marshall	121	170.4	128-214	17.9
8	Bottom Soils, Hamburg, Ida, Monona	103	147.4	97-198	22.8
Total		1,586	163.5	60-228	27.2

Table 10. The "F" results of the analysis of variance of farm family level of living indexes for townships, for all two-area combinations of soil association areas, and for total, Iowa

Soil association areas	Soil association areas								
	1	2	3	4	5	6	7	8	Total
1	-	2.2	76.1**	0.9	193.1**	509.7**	30.6**	175.0**	
2		-	120.9**	0.1	370.0**	979.6**	36.2**	291.2**	
3			-	74.9**	38.9**	202.3**	9.0**	34.5**	
4				-	233.3**	606.7**	22.9**	176.5**	
5					-	54.3**	74.6**	0.4	
6						-	276.0**	28.0**	
7							-	73.2**	
Total									295.8**

*Significant at the 5 percent probability level
**Significant at the 1 percent probability level

variables and level of living were computed, Table 11. Crop productivity showed a high degree of association with level of living in six of the eight areas. In areas 7 and 8, value of land and buildings showed the higher correlation coefficients. The degrees of association indicated for the individual areas varied widely from those for the state. Correlations for level of living and size of farm ranged from -.02 to +.30; for percent tenancy from -.08 to +.49; for crop productivity from +.48 to +.75; for percent 1940 population is of the 1900 population from -.19 to +.33; for percent rural farm population from -.25 to +.07; for value of implements and machinery from +.17 to +.55; and, for value of land and buildings from +.35 to +.62.

Only in areas 5 and 8 did as many as three variables show a correlation coefficient equal to or above .50 with level of living: crop productivity, value of implements and machinery and value of land and buildings.

Levels of significance of the correlation coefficients equal to or beyond the 1 percent level of probability were indicated in all areas for crop productivity, value of land and buildings and value of implements and machinery. Percent rural farm population showed a significant correlation only in area 8. In areas 2 and 4, six of the seven variables showed a significant or highly significant correlation with level of living, while in areas 5 and 8 five of the variables did so. From the correlation coefficient

Table 11. Simple correlations of the selected variables with farm family level of living indexes for townships, by principal soil association areas, Iowa

Soil association areas	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
1	.01	.02	.64**	-.14	-.08	.38**	.35**
2	.21**	.13*	.59**	-.19**	.07	.37**	.41**
3	.20**	-.01	.69**	.13	.01	.33**	.61**
4	.30**	.49**	.75**	.13*	.01	.43**	.52**
5	.04	.25**	.71**	.33**	-.10	.55**	.62**
6	-.02	.32**	.66**	.09	-.02	.17**	.61**
7	.20**	.16	.48**	.16	-.11	.36**	.50**
8	.14	-.08	.51**	.29**	-.25*	.50**	.55**
All areas	.11**	.44**	.78**	.20**	-.05	.53**	.75**

*Significant at the 5 percent probability level.
**Significant at the 1 percent probability level.

(r = .44) of level of living and percent of land tenant operated for the state as a whole, it was inferred that there is a propensity to higher tenancy in the higher land value and more productive areas of the state. It should be noted that by soil areas the higher correlations occurred in areas 4 and 6, where ownership ranks relatively high, thus modifying the overall inference.

Level of living and crop productivity were most highly associated in area 4, which is characterized by livestock farming. Contrary to what might be expected the correlation coefficients were lower in areas in which cash grain farming predominates.

In areas 5 and 8 a small amount of positive association between level of living and percent 1940 population is of the 1900 population was indicated. In areas 1 and 2 a small negative relationship was shown.

The value of implements and machinery, while showing a correlation of .53 with level of living for the state as a whole, showed a coefficient that varied considerably from area to area. The correlation coefficient was smallest in area 6, where implements and machinery carried the lowest average value per 100 acres; and highest in area 5 where the average value per 100 acres, although higher than for area 6, still was below that for the state.

Among the various soil areas, correlation coefficients for value of land and buildings and level of living showed rather wide differences. Soil areas 1 and 2, in which cash grain farming is prevalent, had the lowest correlation coefficients.

One of the more important conclusions of the analysis in this chapter is the lack of consistency from area to area in the associational relationship between the variables and level of living. Any generalization that correlation coefficients, as found for the state as a whole, persist on a small area basis is inconsistent with these findings. The differing relationships imply the need for much additional research to find the variables which are consistent in their relationships to level of living, or the relationships imply the need for interpreting level of living more rigidly in terms of the local situation. In either event, additional study is needed to clarify this situation.

The limitations of the simple factor-by-factor analysis are evident. The correlation coefficients do not always give an indication of the relative importance of varia les, because they may have intercorrelation effects not ascertainable from the simple correlation coefficients.

For the analysis of relationships among the seven independent variables (x_1, x_2, x_6, x_7, x_8, x_{11} and x_{12}) and the dependent variable level of living (y), a multiple regression was computed for each of the soil areas to determine the value of the independent variables in predicting level of living in each of the areas. The regression equation was

$$y = a + b_1x_1 + b_2x_2 + b_6x_6 + b_7x_7 + b_8x_8 + b_{11}x_{11} + b_{12}x_{12}.$$

The various beta coefficients in the multiple regression equation were determined by the method of least squares. The equations by principal soil association areas were as follows:

Area 1 $y = 30.4066 + .2808\ x_1 - .2057\ x_2 + .7628\ x_6 - .0217\ x_7 - .0965\ x_8 + .0145\ x_{11} + .0576\ x_{12}$

Area 2 $y = 101.4008 + .1430\ x_1 - .3377\ x_2 + .4138\ x_6 - .0371\ x_7 - .0520\ x_8 + .0161\ x_{11} + .0429\ x_{12}$

Area 3 $y = 56.6978 + .1656\ x_1 - .3092\ x_2 + .5419\ x_6 + .0871\ x_7 - .0751\ x_8 + .0101\ x_{11} + .2114\ x_{12}$

Area 4 $y = 49.6536 + .2480\ x_1 + .2183\ x_2 + .4056\ x_6 + .0949\ x_7 + .0047\ x_8 + .0151\ x_{11} + .0561\ x_{12}$

Area 5 $y = 45.3933 + .1726\ x_1 - .0838\ x_2 + .5029\ x_6 + .1668\ x_7 + .0920\ x_8 + .0147\ x_{11} + .1503\ x_{12}$

Area 6 $y = 55.0120 + .2037\ x_1 - .0248\ x_2 + .3919\ x_6 - .0272\ x_7 - .0566\ x_8 + .0102\ x_{11} + .3315\ x_{12}$

Area 7 $y = 61.2702 + .1545 x_1 + .0931\ x_2 + .2432\ x_6 + .0344\ x_7 - .0510\ x_8 + .0207\ x_{11} + .2661\ x_{12}$

Area 8 $y = 30.9766 + .1678\ x_1 - .4113\ x_2 + .2730\ x_6 + .2340\ x_7 + .0156\ x_8 + .0354\ x_{11} + .2522\ x_{12}$

where x_1 = size of farm

x_2 = percent tenancy

x_6 = crop productivity

x_7 = percent 1940 population is of the 1900 population

x_8 = percent rural farm population

x_{11} = value of implements and machinery

x_{12} = value of land and buildings

y = farm family level of living.

The multiple correlation coefficients (R) by areas ranged from .6031 to .8098, all highly significant. See Table 12. The corresponding coefficients of determination (R^2) ranged from .3637 to .6558. In other words, from 36 to 66 percent of the variation in level of living by areas was associated with the independent variables.

The size of the R's and R^2's, indicated that the variables selected for this analysis did the best job of predicting level of living in the following order of areas: 4, 5, 3, 8, 1, 6, 2 and 7. Identification of those areas in Figs. 8 and 9 showed that, in general, this is a progression from the more mature areas, in which there is considerable heterogeneity of levels of living, to the less mature, more homogeneous level of living areas. However, the progression is not from high to low, or low to high level of living areas. A second observation, following from the first, is that combinations of different kinds of variables are needed to do an equally effective job of predicting level of living in the different areas.

To what extent cultural variations may be a factor in this diversity in predictive value of the seven variables cannot be determined within the scope of this effort. It is hypothesized, however,

determination, standard partial regression coefficients and their principal soil association areas

regression coefficients (b' 's) and their corresponding (t) values								
t_6	b'_7	t_7	b'_8	t_8	b'_{11}	t_{11}	b'_{12}	t_{12}
7.61**	-0.025	0.26	-0.143	1.60	0.202	2.49*	0.085	0.92
7.46**	-0.087	1.82	-0.087	1.82	0.262	5.83**	0.068	1.12
4.74**	0.171	2.59*	0.091	1.52	0.132	2.06*	0.190	2.02*
6.97**	0.087	1.86	0.005	0.11	0.232	3.85**	0.103	1.92
6.40**	0.189	3.88**	0.093	2.04*	0.201	2.82**	0.176	2.06*
4.37**	-0.069	1.23	-0.065	1.32	0.113	1.49	0.356	3.59**
2.39*	0.033	0.33	-0.073	0.74	0.195	2.20*	0.245	2.43*
2.16*	0.217	2.24*	0.018	0.19	0.352	3.49**	0.225	2.25*
14.36**	-0.004	0.26	-0.018	1.09	0.146	7.59**	0.328	10.52**

(1) that how farm people define their individual and group situation is an important determinant of the level of living to be found within an area; (2) that definitions of situations may be independent of a uniform set of criteria; (3) that the diversity in predictive value of the seven variables was not altogether attributable to those variables, but that the four components in the level of living index may not be uniformly adapted to the measuring of level of living in different areas of the state. Only by further research can the above hypotheses be tested.

In order to assess the contribution of each of the seven variables, a standard partial regression analysis was done, partialing out six of the seven variables at a time to determine the existing relationship between level of living and any single variable playing upon it when the other six variables were held constant. The standard partial regression coefficients (b') for the seven variables and their corresponding (t) values are shown in the above table.

It will be recalled that on a state basis five of the seven partial regression coefficients were significant at the 1 percent probability level. On the soil area basis, from three to six variables were found significant or highly significant. For areas 1, 4 and 6 only three of the seven variables were significant or highly significant. For areas 2 and 7 there were four variables and for areas 3, 5 and 8 there were six. The latter three areas were among the top four wherein the variables in combination did the best

job of predicting level of living.

A comparison of the importance of the partial coefficients by areas with those for the state as a whole was made next. Size of farm (b'_1), percent tenancy (b'_2), crop productivity (b'_6), value of implements and machinery (b'_{11}), and value of land and buildings (b'_{12}) were highly significant for the state as a whole. Only in areas 3 and 8 were these same five variables also found to be significant or highly significant in terms of predictive value. The variable percent 1940 population is of the 1900 population (b'_7), which was non-significant on the state basis, was found to be significant in areas 3 and 8 and highly significant in area 5. Percent rural farm population (b'_8), which also was non-significant for the state, was found to be significant in area 5. Only two variables, size of farm (b'_1) and crop productivity (b'_6) were found to be significant or highly significant in all eight of the areas; value of implements and machinery was found to be so in seven of the eight areas.

For the state, crop productivity (b'_6) and value of land and buildings (b'_{12}) showed relatively high standard partial regression coefficients. For the soil areas, crop productivity (b'_6) and size of farm (b'_1) in that order, showed relatively high coefficients, while the coefficients for value of land and buildings varied considerably from area to area.

These observations indicated that while certain variables held

relatively high standard partial regression coefficients with level of living on a state basis. Such relationships did not hold up consistently on a soil area basis. Significance on a state basis did not necessarily follow on the soil area basis, and vice versa, variables non-significant on the state basis showed up as significant or highly significant in some of the soil areas.

In the simple correlation analysis, Table 11, crop productivity, value of implements and machinery and value of land and buildings showed relatively high correlations with level of living, while the remaining factors showed no consistent high correlation, or practically none at all, throughout the eight areas.

In the following tables the simple correlation coefficients are examined for all paired combinations of the seven variables for each of the principal soil association areas.

Out of a possible 21 significant and/or highly significant correlations of paired combinations of variables for each area, the range was from nine in area 8 to 16 in area 6. From six to seven clusters of interdependencies or interrelationships were found in each of the areas. Each of the clusters consisted of all of the significant correlations between any one variable and all other variables within a given area, Table 21. The clusters ranged from two to seven variables each. An inspection of Tables 13 to 20 showed that the combinations of variables and the degree of association varied considerably from area to area. In some areas the interrelationships were relatively high; in others they were

Table 13. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 1, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.04	-.31	-.26	.18	-.38	-.53
Percent farm land tenant operated	.04	1.00	.10	.06	.01	.03	.01
Crop productivity index	-.31	.10	1.00	-.19	.00	.41	.51
Percent 1940 population is of the 1900 population	-.26	.06	-.19	1.00	-.68	-.03	.07
Percent rural farm population	.18	.01	.00	-.68	1.00	-.05	-.65
Value of implements and machinery per 100 acres	-.38	.03	.41	-.03	-.05	1.00	.59
Value of land and buildings per acre	-.53	.01	.51	.07	-.65	.59	1.00

Significant values are .17 to .22. Those of .23 and above are highly significant, d.f. = 126.

Table 14. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 2, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.29	.19	-.12	.33	-.17	-.14
Percent farm land tenant operated	.29	1.00	.41	-.10	.05	.03	.22
Crop productivity index	.19	.41	1.00	-.27	.12	.26	.65
Percent 1940 population is of the 1900 population	-.12	-.10	-.27	1.00	-.42	.02	-.03
Percent rural farm population	.33	.05	.12	-.42	1.00	.01	-.09
Value of implements and machinery per 100 acres	-.17	.03	.26	.02	.01	1.00	.34
Value of land and buildings per acre	-.14	.22	.65	-.03	-.09	.34	1.00

Significant values are .11 to .14. Those of .15 and above are highly significant, d.f. = 332.

Table 15. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 3, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.17	.21	-.34	.26	-.35	-.10
Percent farm land tenant operated	.17	1.00	.14	.04	.03	.02	.04
Crop productivity index	.21	.14	1.00	.06	-.03	.32	.77
Percent 1940 population is of the 1900 population	-.34	.04	.06	1.00	-.48	.61	.29
Percent rural farm population	.26	.03	-.03	-.48	1.00	-.21	-.11
Value of implements and machinery per 100 acres	-.35	.02	.32	.61	-.21	1.00	.52
Value of land and buildings per acre	-.10	.04	.77	.29	-.11	.52	1.00

Significant values are .14 to .17. Those of .18 and above are highly significant, d.f. = 179.

Table 16. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 4, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.25	.12	-.19	.17	-.40	-.07
Percent farm land tenant operated	.25	1.00	.54	-.02	.05	.15	.30
Crop productivity index	.12	.54	1.00	.11	-.04	.53	.61
Percent 1940 population is of the 1900 population	-.19	-.02	.11	1.00	-.45	.19	.14
Percent rural farm population	.17	.05	-.04	-.45	1.00	-.01	-.01
Value of implements and machinery per 100 acres	-.40	.15	.53	.19	-.01	1.00	.51
Value of land and buildings per acre	-.07	.30	.61	.14	-.01	.51	1.00

Significant values are .14 to .17. Those of .18 and above are highly significant, d.f. = 214.

Table 17. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 5, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.00	-.11	-.02	.04	-.47	-.42
Percent farm land tenant operated	.00	1.00	.42	.04	-.08	.18	.27
Crop productivity index	-.11	.42	1.00	.18	-.14	.66	.76
Percent 1940 population is of the 1900 population	-.02	.04	.18	1.00	-.46	.23	.32
Percent rural farm population	.04	-.08	-.14	-.46	1.00	-.13	-.15
Value of implements and machinery per 100 acres	-.47	.18	.66	.23	-.13	1.00	.80
Value of land and buildings per acre	-.42	.27	.76	.32	-.15	.80	1.00

Significant values are .13 to .16. Those of .17 and above are highly significant, d.f. = 253.

Table 18. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 6, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.10	-.28	-.33	.28	-.21	-.44
Percent farm land tenant operated	.10	1.00	.42	-.01	.13	-.03	.33
Crop productivity index	-.28	.42	1.00	.13	-.01	.21	.82
Percent 1940 population is of the 1900 population	-.33	-.01	.13	1.00	-.36	.13	.41
Percent rural farm population	.28	.13	-.01	-.36	1.00	-.13	-.11
Value of implements and machinery per 100 acres	-.21	-.03	.21	.13	-.13	1.00	.24
Value of land and buildings per acre	-.44	.33	.82	.41	-.11	.24	1.00

Significant values are .13 to .16. Those of .17 and above are highly significant, d.f. = 252.

Table 19. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 7, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.24	.11	-.05	.02	-.23	-.14
Percent farm land tenant operated	.24	1.00	.01	-.13	.07	.03	.18
Crop productivity index	.11	.01	1.00	.07	.03	.38	.60
Percent 1940 population is of the 1900 population	-.05	-.13	.07	1.00	-.67	.17	.18
Percent rural farm population	.02	.07	.03	-.67	1.00	.05	-.09
Value of implements and machinery per 100 acres	-.23	.03	.38	.17	.05	1.00	.49
Value of land and buildings per acre	-.14	.18	.60	.18	-.09	.49	1.00

Significant values are .17 to.21. Those of .22 and above are highly significant, d.f. = 120.

Table 20. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 8, Iowa

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.32	-.05	-.09	.02	-.25	-.17
Percent farm land tenant operated	.32	1.00	.17	-.36	.13	.14	-.09
Crop productivity index	-.05	.17	1.00	-.09	-.17	.58	.56
Percent 1940 population is of the 1900 population	-.09	-.36	-.09	1.00	-.57	.03	.27
Percent rural farm population	.02	.13	-.17	-.57	1.00	-.04	-.35
Value of implements and machinery per 100 acres	-.25	.14	.58	.03	-.04	1.00	.55
Value of land and buildings per acre	-.17	-.09	.56	.27	-.35	.55	1.00

Significant values are .19 to .24. Those of .25 and above are highly significant, d.f. = 102.

relatively low, or did not exist at any significance level. About 36 percent of the interrelationships were negatively associated. The clusters as determined by the size of the combinations and the frequency with which the variables entered into the combinations were largest in area 6 followed in order by areas 5, 2, 3, 4, 1, 7 and 8. This suggests that in area 6, fewer variables might have been used to predict level of living. Further inquiry will be necessary to determine this. Actually, whether or not fewer variables will do the job depends on the degree of association between any pairs of variables. In Tables 13 to 20 very few intercorrelations were found of sufficient magnitude as to result in the variables dividing the effect between themselves on level of living. Most of the variables when placed into a regression equation acted independently of each other in their effect on the dependent variable level of living. The significant correlations for each variable with every other variable and the number of areas in which they occurred are summarized in the following discussion.

Area by area, size of farm was correlated significantly with from two to six variables; with crop productivity in four areas; with value of implements and machinery in eight areas; and, with each of the other variables in five areas.

Percent tenancy was significantly correlated with from two to four variables; with size of farm, crop productivity and value of land and buildings in five areas each; with value of implements

Table 21. Clusters of significant interrelationships among the seven variables used in the multiple regression equation, by principal soil association areas and total

Area	1[a] Size of farm, acres	2 Percent of farm land tenant operated	3 Crop productivity index	4 Percent 1940 population is of the 1900 population	5 Percent rural farm population	6 Value of implements and machinery per 100 acres	7 Value of land and buildings per acre	Unduplicated total of paired combinations[b]
1	3,4,5,6,7		1,4,6,7	1,3,5	1,4,7	1,3,7	1,3,5,6	11
2	2,3,4,5,6,7	1,3,7	1,2,4,5,6,7	1,3,5	1,3,4	1,3,7	1,2,3,6	14
3	2,3,4,5,6	1,3	1,2,6,7	1,5,6,7	1,4,6,7	1,3,4,5,7	3,4,5,6	14
4	2,4,5,6	1,3,6,7	2,6,7	1,5,6,7	1,4	1,2,3,4,7	2,3,4,6	13
5	6,7	3,6,7	2,4,5,6,7	3,5,6,7	3,4,6,7	1,2,3,4,5,7	1,2,3,4,5,6	15
6	3,4,5,6,7	3,5,7	1,2,4,6,7	1,3,5,6,7	1,2,4,6	1,3,4,5,7	1,2,3,4,6	16
7	2,6,7	1,7	6,7	5,6,7	4	1,3,4,7	1,2,3,4,6	10
8	2,6	1,4	6,7	2,5,7	4,7	1,3,7	3,4,5,6	9
All areas	2,3,4,5,6,7	1,3,4,6,7	1,2,4,5,6,7	1,2,3,5,6,7	1,3,4,6,7	1,2,3,4,5,7	1,2,3,4,5,6	20

[a] Numbers shown at top of table correspond to the 7 variables and are used in the body of the table to identify variables in each of the clusters of interrelationships.

[b] The number of pairs of significant correlations shown in the table represents a duplicated total. For example, size of farm and crop productivity are shown as having a significant correlation. In turn, crop productivity and size of farm are shown as having a significant correlation. This was presented in this manner to show readily all possible significant pairs of correlations for each variable.

and machinery in two areas; and with percent 1940 population is of the 1900 population and percent rural farm population in one area each.

Crop productivity was significantly correlated with from two to six variables; with value of implements and machinery and value of land and buildings in eight areas; with percent tenancy in five areas; with size of farm and percent 1940 population is of the 1900 population in four areas; and, with percent rural farm population in two areas.

Percent 1940 population is of the 1900 population was significantly correlated with from three to five variables; with percent rural farm population in eight areas; with value of land and buildings in six areas; with size of farm and value of implements and machinery in five areas; with crop productivity in four areas; and percent tenancy in one area.

Percent rural farm population was significantly correlated with from one to four variables; with percent 1940 population is of the 1900 population in eight areas; with size of farm in five areas; with value of land and buildings in four areas; and with value of implements and machinery, crop productivity, and percent tenancy in three, two, and one areas, respectively.

Value of implements and machinery was significantly correlated with from three to six variables; with size of farm, crop productivity, and value of land and buildings in eight areas; with percent 1940 population is of the 1900 population in five areas; and with

percent rural farm population and percent tenancy in three and two areas, respectively.

Value of land and buildings was significantly correlated with from four to six variables; with crop productivity and value of implements and machinery in eight areas; with percent 1940 population is of the 1900 population in six areas; with size of farm and percent tenancy in five areas each; and with percent rural farm population in four of the areas.

A summation of all of the significant correlations for all of the areas for each variable showed that value of land and buildings was significantly correlated with other variables 36 times out of a possible 48 significant correlations. This was followed by value of implements and machinery 34, size of farm 32, crop productivity 31, percent 1940 population is of the 1900 population 29, percent rural farm population 23, and percent tenancy 29 times.

The extent and degree of relationship between and among the variables used in the multiple regression equation to predict level of living varied markedly from area to area. The same two variable combinations of significant correlations and clusters of interdependencies shown for the state, Table 21, occurred only in area 2 for the variables size of farm and crop productivity, and in area 5 for the variables value of implements and machinery and value of land and buildings. In all other instances, the number of significant two variable correlations and the size of the clusters of

interdependencies was smaller than that for the state.

F. Summary

Analysis in this chapter has shown the soil association areas to be better adapted than type of farming areas for making gross delineations of differential level of living areas. The findings suggest fruitful possibilities for further analysis by soil types and various combinations of soil types.

While wide ranges in levels of living were found in each of the areas, the clustering of indexes within fairly narrow limits as shown by the standard deviations was evident. Homogeneity tended to prevail in the more level and less mature areas of the state, while heterogeneity tended to prevail in the more mature and more dissected areas.

In 24 of the possible 28 two-area combinations, a highly significant difference in level of living was found. Areas 1, 2 and 4 and areas 5 and 8, whose means were nearest alike, showed no significant difference. The first two areas are characterized by cash grain farming, while in the third, livestock farming predominates. All are relatively level. In areas 5 and 8 a mixed type of farming is carried on. Both are characterized by considerable dissection and both showed the greatest heterogeneity in levels of living.

Of the seven independent variables, crop productivity, value of implements and machinery and value of land and buildings showed

wide variation from area to area. All three, however, tended to show correspondingly high values in certain areas and low values in others.

In correlating each of the seven variables with level of living, crop productivity showed the highest simple correlation coefficients in six of the eight areas. In the other two, value of land and buildings showed the highest coefficients. Value of implements and machinery showed coefficients which tended to parallel those of value land and buildings, except in areas 3 and 6, where they were considerably below those of the latter. The lack of consistency from area to area in the associational relationships of the several variables with level of living was especially evident.

The multiple correlation coefficients (R) by areas ranged from .6031 to .8098. The coefficients of determination (R^2) ranged from .3637 to .6558. Thus from 36 to 66 percent of the variation in levels of living by areas was found to be associated with the independent variables.

The multiple regression analysis generally showed that combinations of different kinds of variables are needed to do an equally effective job of predicting level of living in the different areas. By areas the number of significant predictors ranged from three to six, with the largest number occurring in those areas having considerable heterogeneity in levels of living.

Among the different areas, value of land and buildings showed a significant correlation with other variables more frequently than

did any of the others. This was followed in order by value of implements and machinery, size of farm, crop productivity, percent 1940 population is of the 1900 population, percent rural farm population, and percent tenancy.

When clusters of interrelationships among the variables for each of the areas were examined, a marked shifting in composition of the clusters from area to area was noted. Variables chosen for this analysis showed the highest amount of interrelatedness in area 6 and the least in area 8.

The area to area variations in: (1) the size of correlations between levels of living and the individual variables; (2) correlations among the variables; and (3) the number of significant predictors are important considerations for future analyses of levels of living by soil areas.

VII. DELINEATION OF HOMOGENEOUS FARM FAMILY LEVEL OF LIVING AREAS

A. Introduction

In this chapter the criterion for establishing areas is homogeneity in farm family level of living. The analysis of relationships is carried out as in the preceding chapters.

In general, areas may be classified into two types: formal and substantive.[1] Census tracts, legal incorporations and administrative districts are examples of the first type, which arises through the imposition of formal control or formal boundary lines. The second type, substantive, is not formal or administrative in character, but results from its own internal attributes. For example, climate, soil, topography, culture, or, as with our concern, level of living in any given area differentiate it from an adjacent one.

Homogeneity indicates a similarity of attributes, or the persistence of a single factor throughout an area. A single factor may someti es be considered as a composite. Level of living as used in this study actually is made up of several components and, separately

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[1] A more complete description of these two types of areas is given in Quinn, James A., Human ecology. N. Y., Prentice-Hall, Inc. 1950. p. 37-40.

or jointly, in the resulting index they reflect a whole complex of well-being.

The increasing recognition that conformity between formal and certain substantive areas would expedite handling of many types of formal organizational work and planning, emphasizes the need for extensive and intensive research in the identification and delineation of small areas homogeneous with respect to a whole complex of variables.

It was hypothesized that in homogeneous level of living areas a more consistent relationship between level of living and the variables would be observed than in the non-homogeneous level of living areas or in those established for other purposes.

B. Method of Delineation

The technique used to identify and to delineate the homogeneous level of living areas was a relatively simple one of two major steps. The level of living index of each township first was inspected to see if 13 or more contiguous townships could be found whose indexes were within an interval range of 13 index points. The number 13 was approximately one-half of the standard deviation of the level of living indexes by townships for the state. Any group of contiguous townships with fewer than 13 was arbitrarily disregarded and considered a part of the non-homogeneous portion of the state. The township within each group of townships whose farm family level of

living index was such that 12 or more contiguous additional townships could be found by use of the above interval was designated as the pivotal township. The one-half standard deviation interval yielded 20 homogeneous areas including 331 townships, or just over one-fifth of the total townships in the state. The number of townships by areas ranged from 13 to 23. Such homogeneous clusters might be expected to form symetrical groupings about the pivotal townships. Actually the groupings took various asymetrical shapes.

The second step was to expand the level of living interval from 13 to the full standard deviation, 27. Using the larger interval, but continuing the use of the same pivotal townships as with the one-half standard deviation interval, the expansion resulted in secondary areas to those first delineated. Some slight overlapping of areas occurred. This was resolved by assigning the overlapping townships to those areas whose pivotal township had an index value nearest their own. In this process of assigning townships to other areas, two of the 20 originally delineated core areas were eliminated, inasmuch as they were left with fewer than 13 townships each. The 18 core areas now had 304 townships to which were added 455 townships through expansion of the interval for a total of 759. The expansion added from four to 56 townships to each of the 18 core areas, resulting in combined core and secondary areas ranging in size from 18 to 74 townships. See Fig. 10. The mean was 41 townships, or the equivalent of about 2 1/2 counties per area.

In general but little conformity was noted between the areas and type of farming or principal soil association areas. The homogeneous areas included most, but not all, of the level topography of the state and but little of the dissected portions. In general, homogeneity proceeded in a broad belt from the northeast to the southwest part of the state, with the larger areas concentrating roughly in the central part of the state.

A criticism that may be advanced of the above procedure is the use of the original pivotal township for delineation of the secondary area. The assumption would be that with new pivotal townships where the interval of 27 had been substituted for that of 13, homogeneity of the areas would follow new contours. This was tried. The homogeneous areas based solely on the interval of 27 index points were found to be so nearly identical with those areas derived through first delineation of the core areas, and then of the secondary areas, that the two-step procedure was retained. The advantage of first delineating the smaller core areas was that it permitted inspection of the emerging pattern of homogeneous areas and facilitated the delineation of the secondary areas and assignment of overlapping townships. The results of this process led to the conclusion that with any other interval in level of living indexes of between 13 and 27, considerable similarity of areas would occur to those delineated.

Table 22. Number of townships in the core and secondary portions of each of the homogeneous level of living areas by appropriate level of living index interval

Area	Core area[a]		Secondary area[b]		Total townships[c]
	Level of living index interval	Townships	Level of living index interval	Townships	
1	182-194	13	175-201	38	51
2	189-201	31	182-208	10	41
3	176-187	14	168-194	27	41
4	163-175	14	156-182	27	41
5	124-136	14	117-143	13	27
6	152-164	14	145-171	14	28
7	182-194	23	175-201	31	54
8	185-197	23	178-204	51	74
9	190-202	15	183-209	22	37
10	184-196	13	177-203	21	34
11	171-183	14	164-190	39	53
12	162-174	13	155-181	56	69
13	169-181	14	162-188	4	18
14	177-189	15	170-196	10	25
15	167-179	15	160-186	12	27
16	147-159	23	140-166	25	48
17	127-139	15	120-136	40	55
18	128-140	21	121-147	15	36
Total		304		455	759

[a] Size of interval for determining the core areas was 1/2 of the standard deviation for the state. Standard deviation for the state was 27.

[b] Size of interval for core area and secondary area combined was 1 standard deviation or 27.

[c] The slight discrepance in numbers of townships reported in this column and those shown in the areas of Fig. 10 is due to combining townships with small numbers of farms with adjacent larger townships.

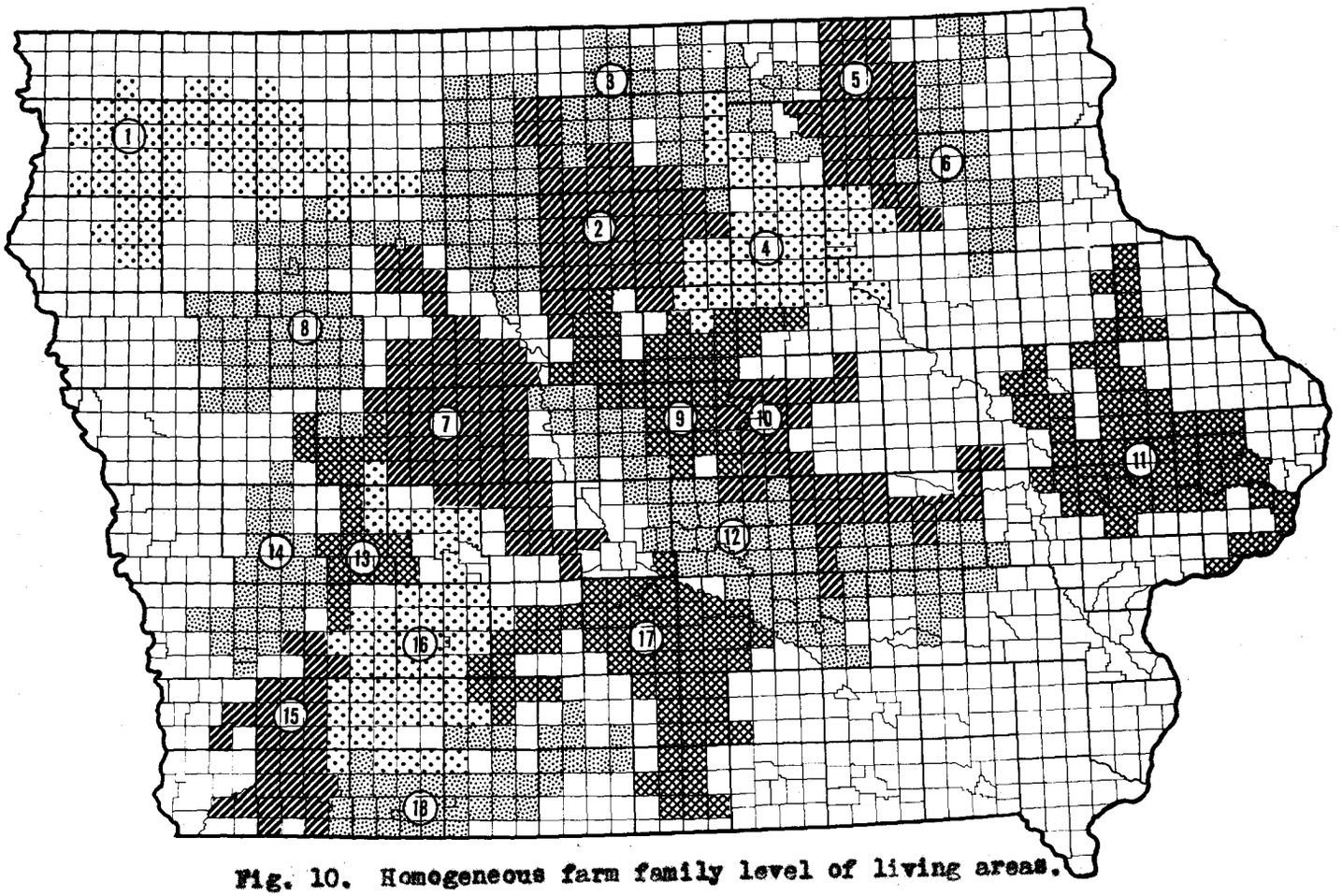

Fig. 10. Homogeneous farm family level of living areas.

C. Selected Characteristics of the Homogeneous and Non-homogeneous Areas

That the homogeneous areas exhibited higher values in the variables used in the analysis than the non-homogeneous areas was a generalization supported by the data. Inspection of the data in Table 23 showed that, with the exception of size of farm, all of the means for the other variables for the aggregate of the homogeneous areas showed higher values than for the non-homogeneous area. The percent 1940 population is of the 1900 population and percent rural farm population, however, showed means only slightly in excess of those for the non-homogeneous area.

Another criterion used for deciding whether homogeneity in level of living contributed to higher values in the seven other variables was determination of the number of homogeneous areas that had variable mean values in excess of the corresponding mean value in the non-homogeneous area. With the exception of size of farm and percent 1940 population is of the 1900 population, variable by variable, comparison showed that more than half of the homogeneous areas had values in excess of the corresponding variable mean values in the non-homogeneous area. These, of course, are crude indicators of the effect of homogeneity of level of living on the variables selected for analysis with level of living, and merely give tentative description of the relationship of level of living to the variables. However, more can be learned through analysis of the relationship

Table 23. A comparison of the means of the independent variables and farm family level of living for the state; total of homogeneous areas and non-homogeneous area; and number of homogeneous areas having means equal to or above means of non-homogeneous area

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre	Farm family level of living index
State	179.2	51.2	95.6	91.2	73.0	$1073	$103	163.9
Homogeneous areas	178.1	53.3	103.2	91.7	73.3	$1138	$111	172.0
Non-homogenous area	180.3	49.3	88.5	90.7	72.6	$1014	$ 96	155.7
Percent mean of homogeneous areas is of mean of non-homogeneous area	98.8	108.1	116.6	101.1	101.0	112.2	115.6	110.5
Number of homogeneous areas having means equal to or above mean of non-homogeneous area	8	14	13	8	10	13	13	13

of level of living to each of the variables in the two types of areas.

D. Relationship of Level of Living to Selected Social and Economic Variables

The simple variable-by-variable correlation analysis provided first approximations of the relative association of the seven variables with level of living for the aggregate of the homogeneous areas and for the non-homogeneous area. Comparison of the two sets of correlation coefficients, Table 24, showed that homogeneity in level of living had the effect of raising the correlation coefficients of the three variables, crop productivity, value of implements and machinery and value of land and buildings when correlated with level of living. Crop productivity showed the largest difference in coefficients.

The simple variable-by-variable analysis tells only part of the story. For the analysis of relationships among the seven independent variables (x_1, x_2, x_6, x_7, x_8, x_{11} and x_{12}) and the dependent variable level of living (y) a multiple regression was computed. The regression equation was:

$$y = a + b_1x_1 + b_2x_2 + b_6x_6 + b_7x_7 + b_8x_8 + b_{11}x_{11} + b_{12}x_{12} \quad .$$

The various beta coefficients in the equation were computed by the method of least squares. The equations for the two types of areas were as follows:

Table 24. Simple correlations between each of the variables and level of living for the combined homogeneous areas and for the non-homogeneous area

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Homogeneous areas	.13**	.37**	.85**	.18**	-.04	.65**	.76**
Non-homogeneous area	.13**	.43**	.73**	.22**	-.07*	.63**	.73**

*Significant at the 5 percent probability level.
**Significant at the 1 percent probability level.

homogeneous area $y = 91.3365 + .1212x_1 - .2645x_2 + .4635x_6 + .0430x_7 + .0026x_8 + .0140x_{11} + .0470x_{12}$

non-homogeneous area $y = 81.7554 + .2038x_1 - .4457x_2 + .2849x_6 - .0935x_7 - .1113x_8 + .0226x_{11} + .2880x_{12}$

where x_1 = size of farm

x_2 = percent tenancy

x_6 = crop productivity

x_7 = percent 1940 population is of the 1900 population

x_8 = percent rural farm population

x_{11} = value of implements and machinery

x_{12} = value of land and buildings

y = farm family level of living.

The multiple correlation coefficient (R) for the combined homogeneous areas was .8717; for the non-homogeneous portion of the state it was .8317. Both coefficients were highly significant. In the combined homogeneous areas 76 percent of the variation in level of living was associated with the independent variables; in the non-homogeneous area, it was 69 percent. The difference between the two coefficients also was highly significant. This tended to support the hypothesis that in the homogeneous level of living areas a more consistent relationship between level of living and the variables will be observed than in the non-homogeneous level of living area. The hypothesis then follows that somewhat different sets of variables are needed to do an equally effective job of predicting level of living in the two types of areas.

determination, and standard partial regression coefficients
areas and the non-homogeneous area

regression coefficients (b's) and their corresponding (t) values								
t'_6	b'_7	t_7	b'_8	t_8	b'_{11}	t_{11}	b'_{12}	t_{12}
17.27**	.064	3.00**	.003	0.14	.213	8.11**	.074	1.89
7.78**	-.123	5.29**	-.096	4.47**	.399	15.12**	.359	8.93**

The contribution of each of the seven independent variables was determined through a standard partial regression analysis by partialing out six of the seven factors at a time to determine the existing relationship between level of living and any single factor playing upon it when the other 11 variables were held constant. Table 25 shows: (1) the standard partial regression coefficients (b') for the seven variables; (2) their corresponding (t) values; and (3) whether or not significant.

For the combined homogeneous areas five of the seven independent variables were found to be significant at the 1 percent probability level. The non-significant variables were percent rural farm population and the value of land and buildings. For the non-homogeneous portion of the state all seven independent variables were found to be highly significant.

It will be recalled that for the state five of the seven variables were significant at the 1 percent probability level. The non-significant variables were percent 1940 population is of the 1900 population and percent rural-farm population. It is evident that for the state, for the combined homogeneous areas and for the non-homogeneous portion of the state the variables differed in their ability to predict level of living.

In the following two tables, 26 and 27, are shown the inter-correlations for the combined homogeneous areas and for the non-homogeneous portion of the state.

Table 26. Intercorrelations among the variables used in the multiple regression equation for the combined homogeneous areas

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.20	.10	-.19	.21	-.21	-.07
Percent farm land tenant operated	.20	1.00	.53	.03	.09	.29	.45
Crop productivity index	.10	.53	1.00	.14	-.02	.65	.86
Percent 1940 population is of the 1900 population	-.19	.03	.14	1.00	-.49	.19	.23
Percent rural farm population	.21	.09	-.02	-.49	1.00	.07	.08
Value of implements and machinery per 100 acres	-.21	.29	.65	.19	.07	1.00	.69
Value of land and buildings per acre	-.07	.45	.86	.23	.08	.69	1.00

Significant values are .08 to .09. Those of .10 and above are highly significant, d.f. = 758.

Table 27. Intercorrelations among the variables used in the multiple regression equation for the combined non-homogeneous area

	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Size of farm, acres	1.00	.28	.14	-.11	.15	-.19	-.12
Percent farm land tenant operated	.28	1.00	.69	.18	-.01	.37	.51
Crop productivity index	.14	.69	1.00	.24	-.04	.52	.83
Percent 1940 population is of the 1900 population	-.11	.18	.24	1.00	-.36	.40	.35
Percent rural farm population	.15	-.01	-.04	-.36	1.00	.00	-.11
Value of implements and machinery per 100 acres	-.19	.37	.52	.40	.00	1.00	.61
Value of land and buildings per acre	-.12	.51	.83	.35	-.11	.61	1.00

Significant values are .08 to .10. Those of .11 and above are highly significant, d.f. = 826.

Out of a possible 21 significant and/or highly significant correlations, there were 17 and 18 by the two types of areas, respectively. In each of the two types of areas seven clusters of interdependencies occurred. Only those variables having significant or highly significant correlation coefficients were used in determining the clusters. The clusters for the combined homogeneous areas ranged from five to seven variables each, and for the non-homogeneous portion of the state, from four to seven variables. A number of the interrelationships were relatively high. About 24 percent of the interrelationships in the combined homogeneous areas were negatively associated, while in the non-homogeneous portion of the state 33 percent were negatively associated.

A summation of the significant correlations for combined homogeneous areas showed that percent tenancy was significantly correlated with other variables six times out of a possible six correlations. This was followed by size of farm, crop productivity, value of implements and machinery and value of land and buildings five, and percent 1940 population is of the 1900 population and percent rural farm population four times.

In the non-homogeneous area, size of farm, percent 1940 population is of the 1900 population and value of land and buildings were significantly correlated with other variables six times out of a possible six correlations. This was followed by percent tenancy, crop productivity and value of implements and machinery five, and percent rural farm population three times.

The same two-variable combinations of significant correlations and clusters of interdependencies for the state, Table 21, occurred in the combined homogeneous areas only for the variable crop productivity. In the non-homogeneous area they occurred for size of farm, percent tenancy, percent 1940 population is of the 1900 population and value of land and buildings. This appears to indicate that the interrelationship behavior of the variables in the combined homogeneous areas differed markedly from that in the non-homogeneous area or in the entire state. Introducing homogeneity reduced: (1) the number of significant standard partial regression coefficients; (2) the number of significantly paired combinations; and (3) the size of the clusters of significant interrelationships compared to those of the non-homogeneous area and those of the state.

E. Summary

Analysis of farm family level of living and its association with other variables by the combined homogeneous level of living areas and the non-homogeneous portion of the state has indicated another technique that may be used in the identification and delineation of the ecological patterns of levels of living or of any other variable.

The homogeneous level of living areas as identified for Iowa do not conform closely to type of farming or principal soil association areas. In general, the areas include most of the level topography

Table 28. Clusters of significant interrelationships among the seven variables used in the multiple regression equation for the combined homogeneous areas and for the non-homogeneous area

	1[a] Size of farm, acres	2 Percent of farm land tenant operated	3 Crop productivity index	4 Percent 1940 population is of the 1900 population	5 Percent rural farm population	6 Value of implements and machinery for 100 acres	7 Value of land and buildings per acre	Unduplicated total of paired combinations[b]
Homogeneous areas	2,3,4,5,6	1,3,5,6,7	1,2,4,6,7	1,2,5,6,7	1,2,3,7	1,2,3,4,7	2,3,4,5,6	17
Non-homogeneous area	2,3,4,5,6,7	1,3,4,6,7	1,2,4,6,7	1,2,3,5,6,7	1,4,7	1,2,3,4,7	1,2,3,4,5,6	18

[a] Numbers shown at top of table correspond to the seven variables and are used in the body of the table to identify variables in each of the clusters of interrelationships.

[b] The number of pairs of significant correlations shown in the table represents a duplicated total. For example, size of farm and crop productivity are shown as having a significant correlation. In turn, crop productivity and size of farm are shown as having a significant correlation. This was presented in this manner to show readily all possible significant pairs of correlations for each variable.

of the state and avoid most of the dissected portion. The larger areas tend to be concentrated in the central part of the state. Homogeneity tends to proceed in a broad belt from northeast to southwest.

As additional data becomes available additional research should be undertaken to further validate the areas delineated here and particularly to unfold areas that are homogeneous with respect to large complexes of internal attributes. Because of its small size the township seems well adapted to use in the identification and delineation of such areas.

Analysis has shown that in Iowa generally the higher mean levels of living are found in those areas which are relatively homogeneous with respect to levels of living, while the lower mean levels are found in the non-homogeneous portion of the state.

Six of the seven variables showed higher mean values in the combined homogeneous areas than in the non-homogeneous portion of the state.

Three of the seven variables, crop productivity, value of implements and machinery and value of land and buildings when correlated with level of living showed higher simple correlation coefficients in the homogeneous area than in the non-homogeneous area. Other variables showed either equal or lower correlation coefficients.

The multiple correlation coefficients (R) for the two areas were .8717 and .8317, respectively. The difference was statistically highly significant. The coefficients of determination (R^2) were

76 and 69 percent, respectively. This led to the conclusion that the variables used in this analysis do a better job of predicting level of living in the homogeneous rather than in the non-homogeneous portion of the state.

The fact that the five highly significant standard partial regression coefficients in the combined homogeneous areas did a better job jointly than did the seven highly significant coefficients in the non-homogeneous area of predicting level of living suggests that fewer variables may be used to account for variations in level of living in homogeneous than in non-homogeneous level of living areas.

The clusters of interrelationships among the significant variables showed some shifting in the composition of the clusters from one type of area to the other. In the non-homogeneous area four of the seven clusters conformed to those found for the state as a whole while only one did so in the homogeneous areas.

VIII. ECOLOGY OF FARM FAMILY LEVEL OF LIVING AND SELECTED SOCIAL AND ECONOMIC VARIABLES

A. Introduction

This study has been concerned with analyses of farm family level of living and related variables, proceeding from an overall analysis for the entire state to one by type of farming areas, by principal soil association areas, and by homogeneous and non-homogeneous level of living areas. The methods and techniques illustrated only in gross manner the location of small areas in which a close relationship existed between each of the variables and level of living.

The analysis in this chapter centers around an attempt to show geographically, township by township, where in Iowa there was general correspondence in the rank of level of living in relation to each of the variables. The technique combined both statistical data and mapping.

B. Ranking of the Data

The first step in this analysis was to group the data for all the variables. The six level of living index intervals, as employed previously, were used as the control for grouping the other seven variables. The level of living index intervals and number of

townships in each were as follows:

Intervals	Number of townships
Under 120	106
120-139	201
140-159	346
160-179	436
180-199	386
200 and over	111
Total	1,586

The values for each of the variables were arrayed from low to high. Starting with the lowest value in each of the arrays, 106 township values were counted. An arbitrary interval break was established between the 106th and the 107th values, followed by counting the next 201 township values and establishing the next interval, and so on through the six intervals. The level of living intervals, with the exception of the lowest and highest, were of equal size; for the other variables the range in the intervals differed.

In the process of establishing intervals for the seven variables, certain township variable values falling in the array at the terminal points of an interval arbitrarily were assigned to the one just above or just below in order to complete the required number of values in each. When this was done, consideration was given to the ranking of all other values of the particular township. In this

manner a minimum of bias was introduced. After all of the values were grouped, it was then possible to see how any stated township in a given level of living index interval ranked with respect to the other variables. If a township variable value fell into the same interval with that of level of living, then it was considered as closely associated with level of living.

C. Method of Mapping Ranked Data

Having determined whether or not the township variable values (x_1, x_2, x_6, x_7, x_8, x_{11}, and x_{12}) were in the corresponding interval with the level of living index interval, the information was placed in the following manner on an outline map of Iowa showing all townships. Intervals were assigned numbers from one to six. If the level of living in a township ranked in the third interval and crop productivity for the same township also ranked in the third interval, that information was placed on a work map in the appropriate township as 3-3. Other townships may have had rankings of 1-3, 4-5, 5-5, 5-2, etc. The first number always denoted the level of living rank, the second the variable rank. Having completed this step, townships, or groups of townships, showing individual variables in general correspondence with level of living were identifiable. Also it was possible to see the degree of general correspondence between level of living and any other variable. Differences ranged from none to as many as five intervals. In some townships level of living

ranked in higher intervals than did the variable under comparison, and vice versa. This had the effect of showing a lead or lag relationship between level of living and any single variable in any township.

Tables 29 to 35 are presented to show how the several variables distributed themselves in relation to level of living. Table 36 is presented also to show the number of townships that had variable values in corresponding intervals with the level of living index intervals.

It is apparent from Table 36 that correspondence within a number of townships between each variable and level of living did not conform closely with the simple correlations. It will be noted in Table 35 that for the value of land and buildings, 722 townships, or a little more than 45 percent of the total, were in the same interval level with respect to this variable as they were for level of living. This sum was obtained by adding diagonally across the table from the upper left hand corner to the lower right hand corner. In the case of crop productivity, there were 699, or 44 percent of the townships. For the other variables the numbers were smaller. While practically no correlation was shown between level of living and percent rural farm population, 374 townships had values for this variable which fell in the same corresponding intervals as they did for level of living.

The rank or degree of correspondence of level of living by townships in relation to each of the seven variables is shown in Figures

Table 29. Rank distribution of townships by farm family level of living and size of farm

Level of living index intervals	Number of townships by size of farm						Total
	Under 137	137-155	156-173	174-192	193-221	222 and over	
Under 120	11	12	20	23	31	9	106
120 - 139	21	32	43	49	47	9	201
140 - 159	25	50	86	90	71	24	346
160 - 179	32	63	108	110	90	33	436
180 - 199	17	38	79	125	99	28	386
200 and over	-	6	10	39	48	8	111
Total	106	201	346	436	386	111	1,586

Table 30. Rank distribution of townships by farm family level of living and percent of land tenant operated

Level of living index interval	Number of townships by percent of land tenant operated						Total
	Under 34	34-42	43-49	50-57	58-66	67 and over	
Under 120	25	34	27	10	7	3	106
120 - 139	25	46	57	47	23	3	201
140 - 159	35	67	80	85	64	15	346
160 - 179	13	37	97	137	122	30	436
180 - 199	8	16	71	126	120	45	386
200 and over	-	1	14	31	50	15	111
Total	106	201	346	436	386	111	1,586

Table 31. Rank distribution of townships by farm family level of living and crop productivity

Level of living index interval	Number of townships by crop productivity index						Total
	Under 39	39-61	62-89	90-117	118-142	143 and over	
Under 120	61	27	13	5	0	0	106
120 - 139	32	85	63	18	3	0	201
140 - 159	11	75	137	96	26	1	346
160 - 179	2	11	115	188	102	18	436
180 - 199	0	2	17	123	190	54	386
200 and over	0	1	1	6	65	38	111
Total	106	201	346	436	386	111	1,586

Table 32. Rank distribution of townships by farm family level of living and percent 1940 population is of the 1900 population

Level of living index interval	Number of townships by percent 1940 township population is of the 1900 population						Total
	Under 62	62-71	72-81	82-95	96-128	129 and over	
Under 120	39	27	20	12	7	1	106
120 - 139	26	47	53	45	24	6	201
140 - 159	21	57	99	82	58	29	346
160 - 179	15	40	92	131	123	35	436
180 - 199	5	28	65	124	132	32	386
200 and over	-	2	17	42	42	8	111
Total	106	201	346	436	386	111	1,586

Table 33. Rank distribution of townships by farm family level of living and percent rural farm population

Level of living index interval	Number of townships by percent rural farm population[a]					Total
	Under 31	31-47	48-69	70-94	95 and over	
Under 120	3	9	22	34	38	106
120 - 139	12	21	51	50	67	201
140 - 159	27	33	73	95	118	346
160 - 179	33	66	92	124	121	436
180 and over[a]	31	72	108	133	153	497
Total	106	201	346	436	497	1,586

[a]For this variable the fifth and sixth intervals have been combined. The number of townships with 100 percent rural farm population was too large for proper allocation between the 180-199 and the 200 and over intervals.

Table 34. Rank distribution of townships by farm family level of living and value of implements and machinery per 100 acres

Level of living index interval	Number of townships by value of implements and machinery per 100 acres						Total
	Under $535	535-757	758-1005	1006-1239	1240-1569	1570 and over	
Under 120	54	33	14	2	3	-	106
120 - 139	31	78	63	23	6	-	201
140 - 159	15	62	128	92	43	6	346
160 - 179	4	21	95	172	115	29	436
180 - 199	2	6	39	120	173	46	386
200 and over	-	1	7	27	46	30	111
Total	106	201	346	436	386	111	1,586

Table 35. Rank distribution of townships by farm family level of living and per acre value of land and buildings

Level of living index interval	Number of townships by per acre value of land and buildings						
	Under 50	50-70	71-94	95-119	120-160	161 and over	Total
Under 120	62	29	12	3	-	-	106
120-139	31	88	63	18	1	-	201
140-159	10	69	142	96	24	5	346
160-179	2	12	109	189	105	19	436
180-199	-	3	19	110	204	50	386
200 and over	1	-	1	20	52	37	111
Total	106	201	346	436	386	111	1,586

Table 36. Distribution of townships showing by variables number which corresponded with level of living intervals; totals and percent of total of all townships; and, simple correlation between level of living and variables

Level of living index interval	Number of townships by variables							
	Level of living index	Size of farm, acres	Percent of farm land tenant operated	Crop productivity index	Percent 1940 population is of the 1900 population	Percent rural farm population[a]	Value of implements and machinery per 100 acres	Value of land and buildings per acre
Under 120	106	11	25	61	79	3	54	62
120-139	201	32	46	85	47	21	78	88
140-159	346	86	80	137	99	73	128	142
160-179	436	110	137	188	131	124	172	189
180-199	386	99	120	190	132	153	173	204
200 and over	111	8	15	38	8		30	37
Total	1,586	346	423	699	456	374	635	722
Percent of total	100.0	21.8	26.7	44.1	28.8	23.6	40.0	45.5
Simple correlations between level of living and variables		.11	.44	.78	.20	-.05	.53	.75

[a] For this variable the fifth and sixth intervals have been combined. The number of townships with 100 percent rural farm population was too large for proper allocation between the two intervals.

11 to 17. The maps represent a simplification of the data in the tables, since only three types of townships are identified: (1) those in which level of living and the variable in question were in general correspondence; (2) those in which level of living ranked below the variable regardless of whether by one or more intervals; and (3) those in which level of living ranked above the variable by one or more intervals. Ideally, maps should show all degrees of correspondence. Because the large number of interval combinations not only would increase the complexity of such maps, but make reading on a reduced scale very difficult, it was considered inadvisable to include them in this study.

While the tables provided useful statistical information, the maps located such information in geographic place. Inferences and interpretations from the statistical tables can be supplemented with those made from the maps.

D. Discussion of the Results

Although a relatively high correlation coefficient of .78 existed between level of living and crop productivity, that association was not present uniformly throughout the state as shown in Fig. 13. In the western part of the state, farm family level of living tended to rank below that of crop productivity, while in the eastern part of the state level of living ranked above. In the latter portion of the state, dairying and livestock feeding operations contribute more

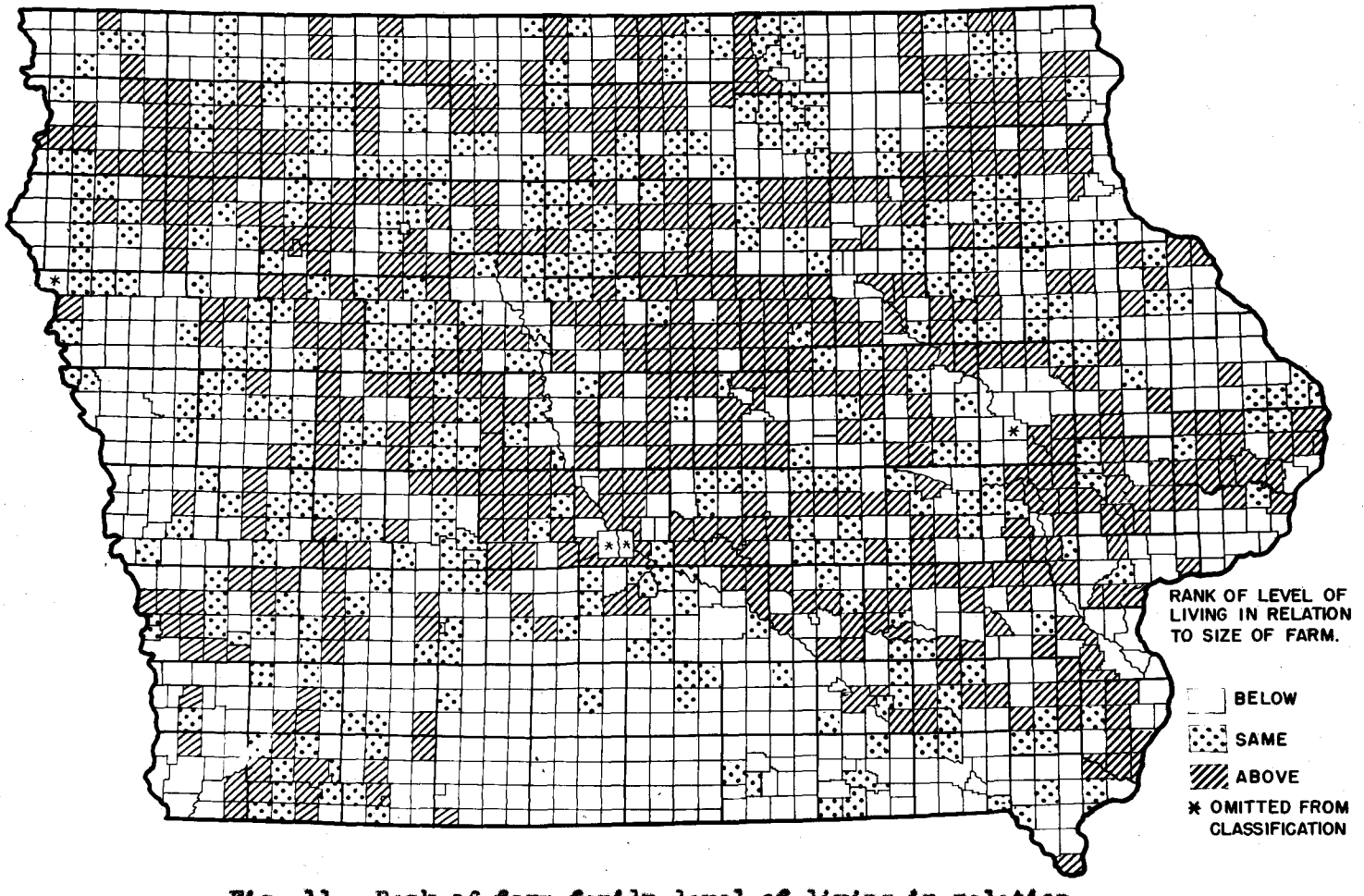

Fig. 11. Rank of farm family level of living in relation to size of farm, by townships

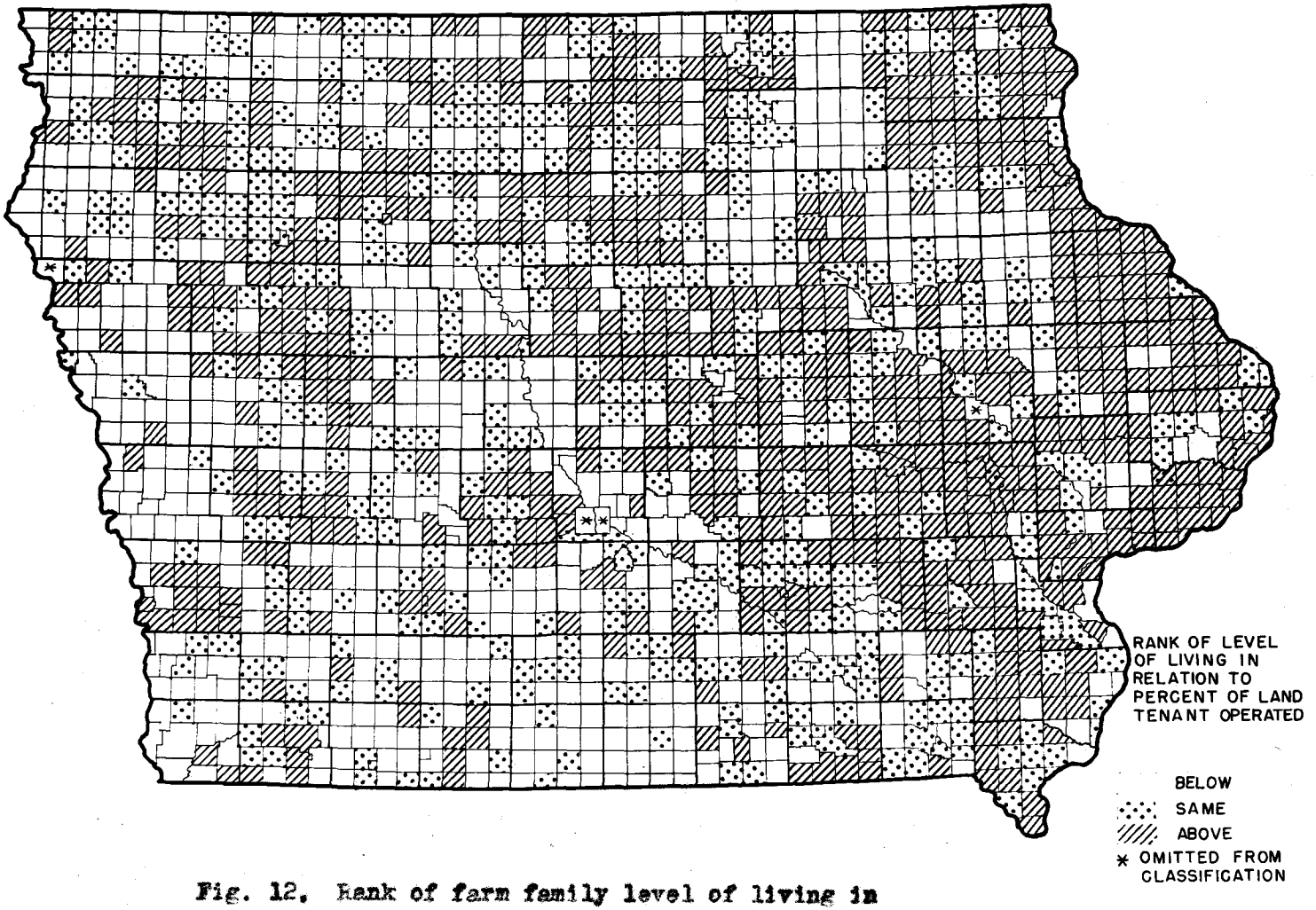

Fig. 12. Rank of farm family level of living in relation to percent of farm land tenant operated, by townships

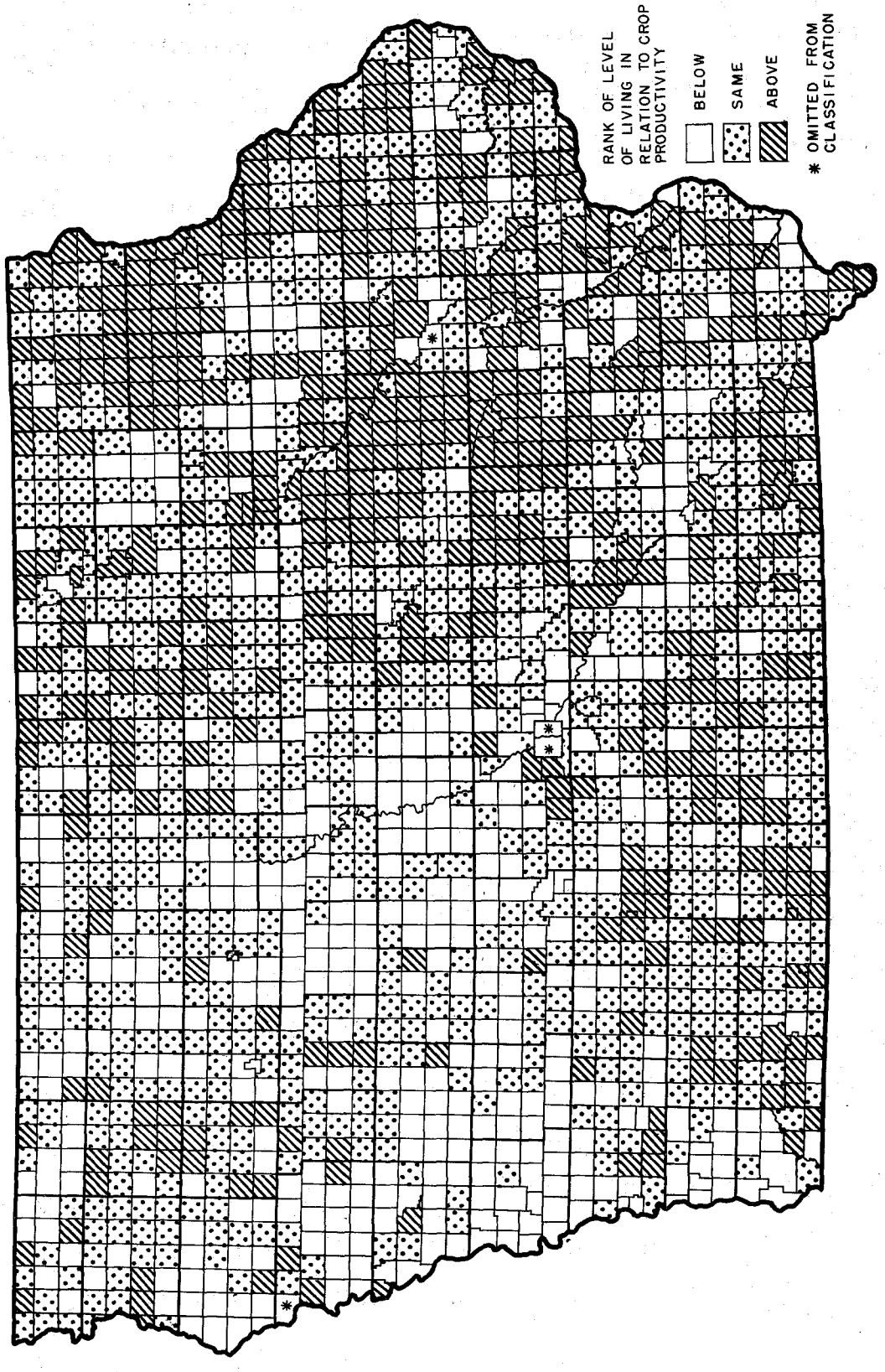

Fig. 13. Rank of farm family level of living in relation to crop productivity, by townships

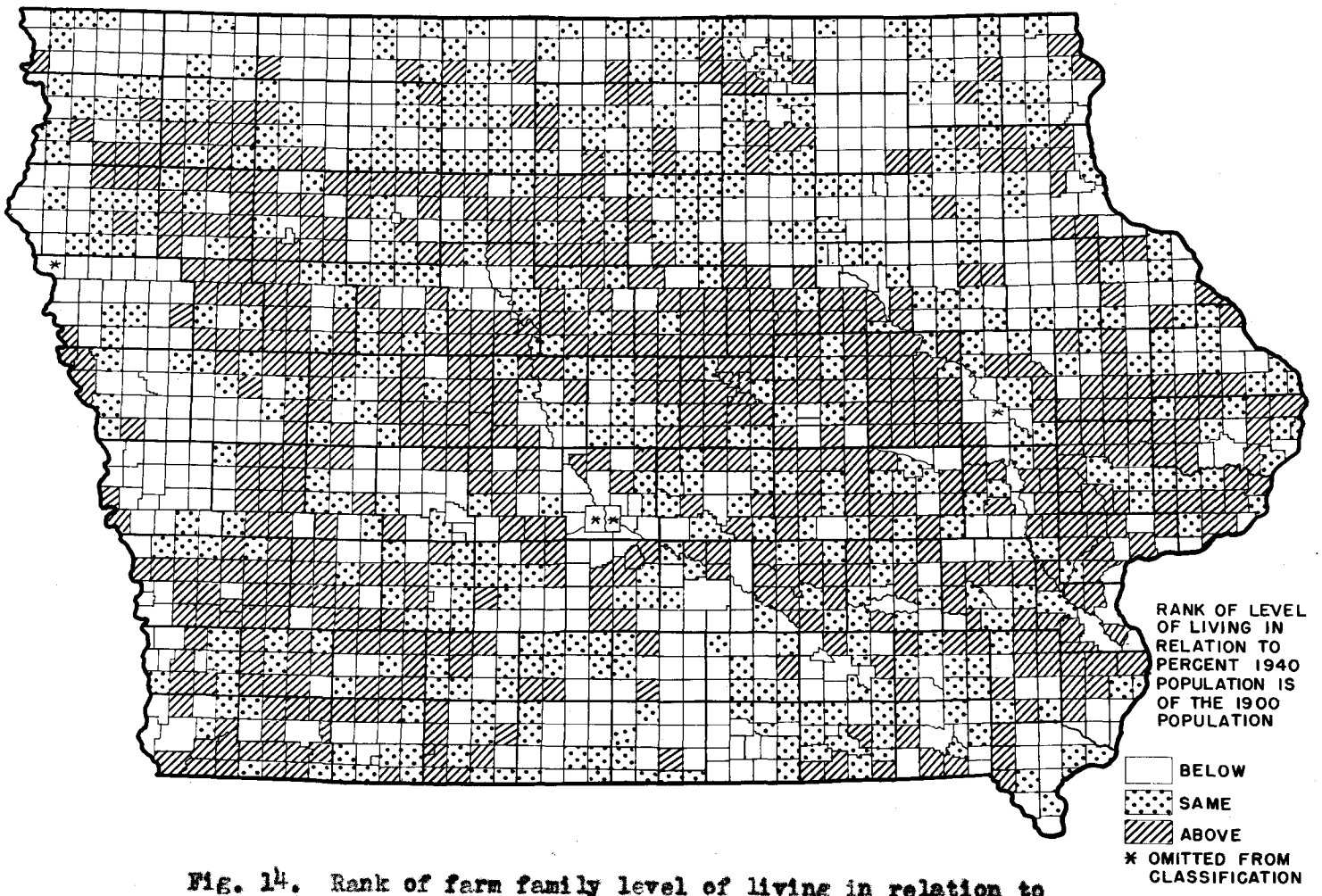

Fig. 14. Rank of farm family level of living in relation to percent 1940 population is of the 1900 population, by townships

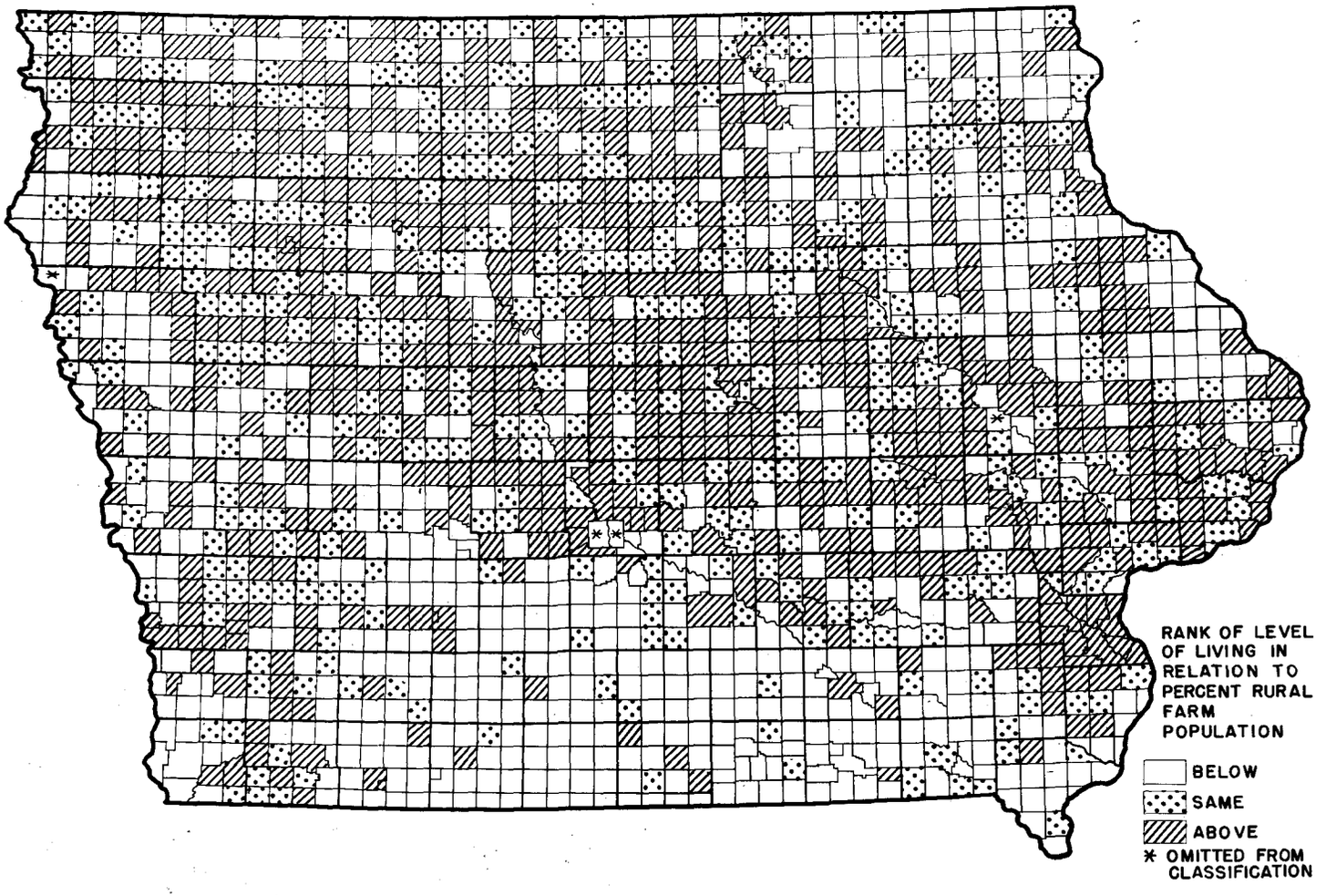

Fig. 15. Rank of farm family level of living in relation to percent rural farm population, by townships

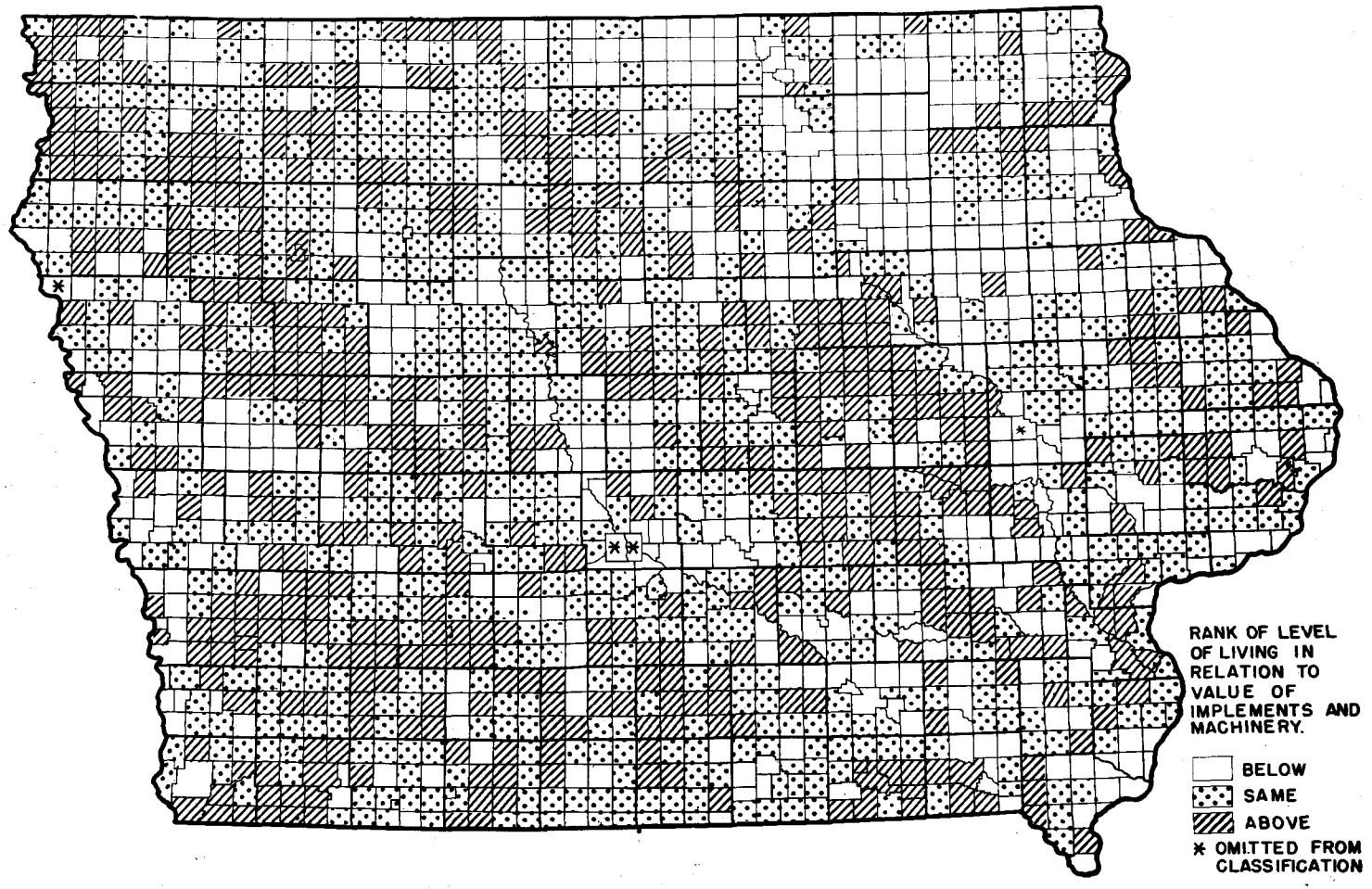

Fig. 16. Rank of farm family level of living in relation to value of implements and machinery per 100 acres, by townships

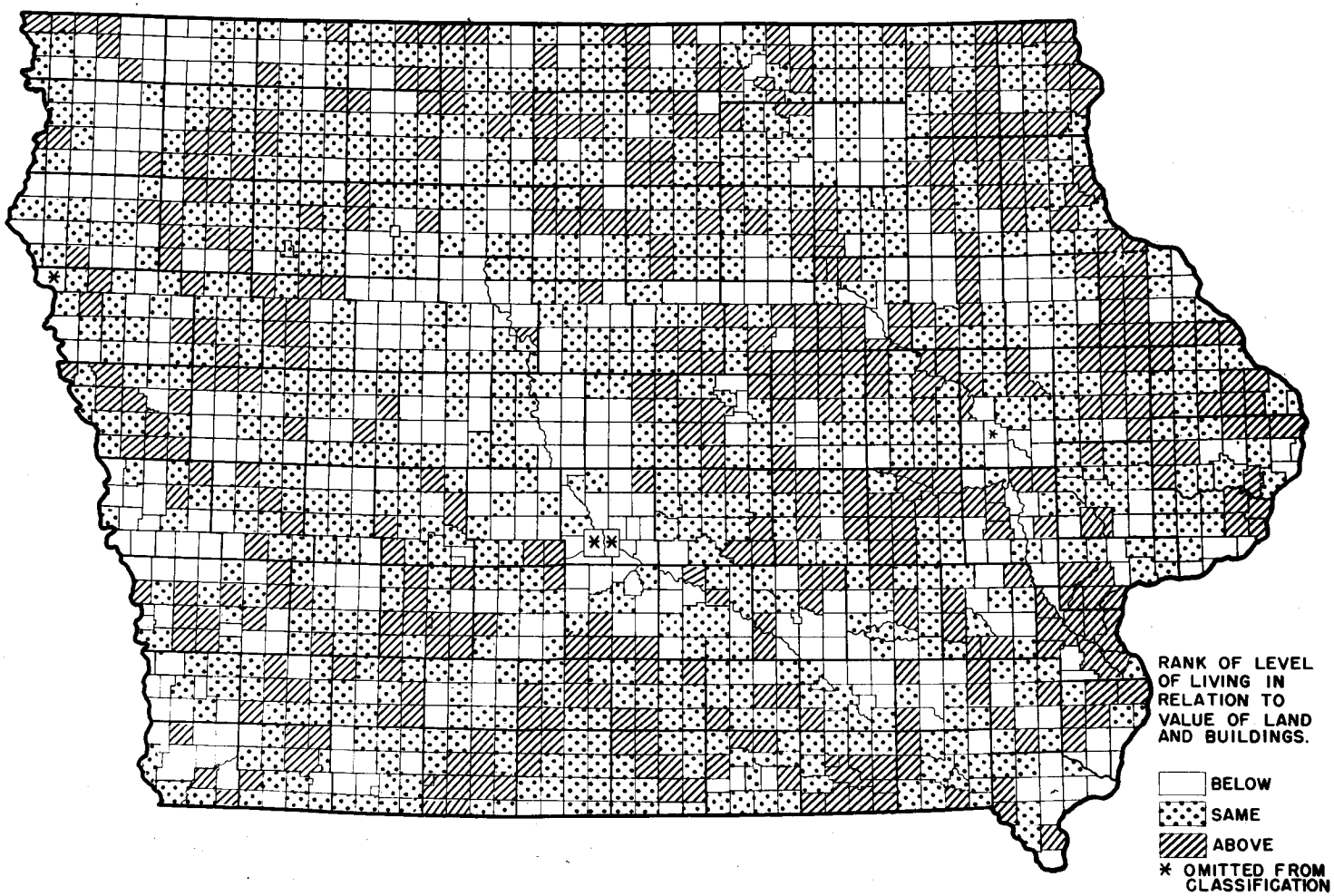

Fig. 17. Rank of farm family level of living in relation to value of land and buildings per acre, by townships

heavily to the farm family's income than crop productivity. In the southern part of the state level of living and crop productivity maintained a relatively close relationship.

Somewhat similar to level of living and crop productivity, townships showing both level of living and value of land and buildings in the same rank, Fig. 17, were fairly well distributed over the entire state. However, it should be noted that townships with a level of living rank higher than that of valuation of land and buildings tended to be located in the eastern half of the state, while in the western half of the state there was some tendency toward the opposite situation.

The relationship of level of living to value of implements and machinery depicted in Fig. 16 showed a pattern somewhat different from that of value of land and buildings or crop productivity. In northeast Iowa the rank of level of living tended to lag behind that of value of implements and machinery. The implication follows that it is necessary proportionally for the families to capitalize heavily in the mechanical means of production in order to maintain a reasonable level of living. In the remainder of the state, with the exception of small interspersed areas, level of living ranked equal to or above that of the value of implements and machinery. Concentrations of townships in which level of living ranked higher were located just east of the central part of the state, in the western and northwestern and in the southern parts of the state. Livestock raising and feeding tends to prevail in most such areas.

In an examination of Fig. 12, showing the relationship of level of living to percent of farm land tenant operated, level of living rank in central and eastern Iowa was generally higher than percent of land tenant operated. The north central and portions of the central western part of the state tended to show a similar relationship. In much of the western and southern parts of the state, percent of land tenant operated often ranked higher than level of living. While for the state as a whole a .44 correlation between these two variables was shown, correspondence between them was not uniform throughout the state.

The relationship of level of living to percent the 1940 population is of the 1900 population is depicted in Fig. 14. This showed that in east central, central, west central and southwest Iowa there are substantial concentrations of townships in which level of living ranked higher than percent the 1940 population is of the 1900 population. Sizeable areas near the northeastern, northern, western and southern borders of the state showed that level of living tended to rank lower than the rank of percent the 1940 population is of the 1900 population. The population information was for total population including urban as well as rural. Therefore, the relationships shown here between farm family level of living and total population were conditioned also by changes that occurred in the urban population during the 40 year period. The areas in which level of living generally carried the higher rank were those settled earlier, and

they followed the pattern of early day migration from southeast to the northwest parts of the state. This seemed to imply that in those areas a reasonably satisfactory adjustment of population to resources was effected relatively early and has remained so in contrast to southern and parts of western Iowa where heavy outmigration has continued over many years.

The relationship of level of living to size of farm given in Fig. 11 showed that in southern Iowa level of living ranked below that of farm size. The larger farms in this less productive area required to yield a given income reflect this situation. In the northeast, east central and in interspersed sections of the southeast and western parts of the state where dairying and livestock raising predominate, level of living usually was found to outrank size of farm. In much of the north central and northwestern cash grain portion of the state a similar situation prevailed. This again might have been expected to occur in the high soil fertility areas of the state where crop yields are relatively high and smaller farms required to produce an abundance of crops.

The relationship of level of living to percent rural farm population, Fig. 15, drew particular attention to the fact that the pattern of level of living rank equal to or exceeding that of percent rural farm population conformed quite closely to the overall distribution of level of living indexes in Iowa. Principal explanation appeared to lie in the fact that practically no correlation (-.05) existed between the two variables. Despite the lack of correlation, 37^{4} townships

had corresponding level of living and percent rural farm population ranks. Similar to the distribution of the level of living indexes by townships, Fig. 1, the northeastern, southern and western parts of the state showed percent rural farm population generally ranking higher than level of living. This may be expected, for these are areas with few centers in the urban classification and as a consequence they have high percentages of the population in the rural classifications. It also indicated that a high degree of rurality does not necessarily carry with it a high level of living.

The general interpretation warranted is that level of living ranks usually were correspondingly higher in those areas characterized by something less than a completely rural population. Determination of the effect of the presence of an urban population in those townships where such was present was not undertaken in this study. The hypothesized positive relationship however, was suggested by the mapped ranks of level of living in relation to percent rural farm population.

E. Summary

The areas of association and dissociation between level of living and each of the seven variables have been observed and discussed. The technique used for showing such association and dissociation has demonstrated the general lack of uniformity of concentration throughout the state of similar ranks between level of living and each of the

variables. This effort can only serve to indicate the large amount of research needed to find any sizeable number of variables which, when associated with farm family level of living, will result in similar areas of concentration.

The identification of such areas has definite implication for various types of research and the structuring and evaluation of programming activities designed to further improve the well-being of the farm people socially and economically.

The advantages of the mapping procedure was that of pointing out in geographic space the location of townships showing general correspondence between level of living and each of the variables taken independently of the others. While correlation coefficients computed for the combined townships of the state gave an indication of the degree of association between level of living and each of the variables, they lacked the ability to identify townships in which such association may be expected. The coefficients, however, did provide an indication of whether much correspondence in ranks could be expected between level of living and each of the variables.

IX. SUMMARY AND CONCLUSIONS

Several techniques for analyzing farm family level of living and related factors in Iowa have been outlined and presented. Basically, the employment of the techniques and the analyses were exploratory. They involved the study of farm family levels of living on a state basis, type of farming area basis, principal soil association area basis, homogeneous level of living area basis and included a determination of the ecological relationship of level of living to each of seven variables. Analyses of the relationship of levels of living to the variables on the state, soil association and homogeneous level of living area bases were made. An analysis of change in levels of living 1940 to 1945 also was made.

All of the data were obtained from published and unpublished secondary sources, including data from the federal census, from assessors' records, from publications and files of the Bureau of Agricultural Economics, U. S. D. A. and from publications and files of the Department of Economics and Sociology, Iowa State College.

The thesis underlying this exploratory effort is that despite the general impression that farm families in Iowa have a high level of living, wide variations are to be found. Corollary to this is that any level of living is the product of many interacting variables and that the interactive patterns will vary from area to area.

The development and availability of farm family level of living indexes by townships suggested the possibility of exploratory work toward effectively delineating areas which more adequately represent the product of local physical, social and economic conditions than do the county indexes. Indexes by townships are fairly sensitive indicators of the differences within counties or other areas and generally are adaptable to analysis by areas having irregular configurations, to identification of homogeneous and non-homogeneous level of living areas, and to description and analysis of the township by township relationship of level of living to other variables.

In the analysis of areas within the state, this study started out with type of farming areas as a point of departure. Significant differences in levels of living were indicated mainly between Southern Pasture and each of the other four areas. While of considerable value in analyzing farm conditions, the type of farming areas did not appear well adapted for use in level of living analysis.

The assumption that soil association areas differentiate levels of living had a reasonable amount of support from this analysis. Homogeneity in levels of living was more prevalent in those areas characterized by a level topography than in the dissected areas. In each soil association, the clustering of indexes within fairly narrow limits was indicative of the propensity to homogeneity in levels of living on an area basis.

Areas of contiguous townships delineated solely on the basis of homogeneity in levels of living were found to lack close conformity

with either type of farming areas or soil association areas. Homogeneity was found to proceed, for the most part, in a broad belt from northeast to southwest Iowa and to include most of the level topography of the state. In general, higher levels of living and higher values for most of the variables prevailed in the homogeneous rather than in the non-homogeneous part of the state.

The ecological delineation of the correspondence between farm family level of living and the seven variables indicates areas in the state where a close association exists between level of living and each of the variables. The mapping of these relationships provided a technique whereby association and dissociation may be identified in place. In general, the variables showing the highest statistical relationship with level of living also resulted in the largest number of townships on the map showing the close association.

The relationships between level of living and the variables were determined by means of simple correlations, multiple correlation and multiple regression analyses. Generally and irrespective of the type of area, crop productivity was found to be most closely related to level of living with values of land and buildings, value of implements and machinery, and percent tenancy following in that order. Other variables showed relationships of lower magnitude.

A regression equation using size of farm, percent tenancy, crop productivity, percent 1940 population is of the 1900 population, percent rural farm population, value of implements and machinery and value of land and buildings was found to be highly correlated on a

state basis with farm family level of living (R = .81). By soil association areas the correlations (R) ranged from .60 to .81. For the homogeneous and non-homogeneous areas the correlations (R) were .87 and .83, respectively.

Standard partial regression analyses using the seven variables showed that crop productivity and farm size were consistently significant predictors of level of living regardless of type of areas considered. These variables were followed closely by value of implements and machinery and value of land and buildings. In about half of the areas, percent tenancy and percent 1940 population is of the 1900 population had significant coefficients. Percent rural farm population was the least important.

The lack of consistency in number and kind of significant variable predictors of level of living from area to area is of special importance to all persons, groups and agencies concerned with the welfare of the farm population. With further duplication of this study or of various aspects of it, more adequate guidance in the different areas of the state could be given to various activities with which farm people are concerned.

The limited availability of statistical measures on a township basis for many pertinent social and economic variables was perhaps the most serious problem in this study. However, with the publication of the 1950 federal census most of the data appearing in published form for counties also will be available for townships either in published or unpublished form. Consequently in future researches

greater choice in variables suitable for determination of areas and for relationship analyses will be possible.

Contributions of the study were: (1) a demonstration of the usefulness of the farm family level of living indexes by townships to indicate the existent wide variations in and uniform concentrations of levels of living; (2) the adaptation of township indexes to analysis by soil association or any other areas with irregular contours; (3) identification and delineation of small homogeneous level of living areas by use of indexes; (4) the usefulness of the indexes in mapping township by township the relationship of rank of level of living and that of each of the variables; (5) the determination of the lack of consistency from area to area in the associational relationship of the several variables to level of living; and (6) the determination of the differences in ability of variables to predict level of living from area to area.

Other investigations might well include: (1) a further validation of the relationship of soil associations and particularly soil types to levels of living; (2) further validation of the homogeneous level of living areas and an analysis of their unique characteristics with some experimentation to determine their usefulness as areas for other types of social and economic research; (3) attempts to delineate areas which are homogeneous with respect to large complexes of internal attributes including level of living; (4) studies of level of living time series data by areas and the relationship of change in levels of living to that of related variables; (5) determination

of causes of differing changes over time in level of living when initial level of living indexes are the same; (6) identification of individual and groups of townships in which a uniform set of variables predicts level of living with a high degree of reliability; and (7) experimental testing in different level of living areas of the effects of an educational program for increasing level of living.

The identification and analysis of differentials in farm family level of living on a small area basis is of basic importance to the social scientist, for it provides a means whereby the spatial aspects of society can be studied as separate segments of a unified whole. This is needed to supplement and enrich the findings of the various regional studies and of such subjects as social organization, social participation, population and migration, institutions and public and private services.

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XI. ACKNOWLEDGMENTS

The author is deeply grateful to Dr. Ray E. Wakeley for his counsel and encouragement in graduate study and in the preparation of this thesis. To the other members of his committee, Drs. Joseph B. Gittler, James E. Wert, John F. Timmons and Iver B. Johnson, he wishes to express sincere thanks.

Special appreciation is extended to Dr. Carl C. Taylor, Head of the Division of Farm Population and Rural Life, Bureau of Agricultural Economics, U. S. Department of Agriculture for inspiration and counsel during the formulation and early stages of this study. Useful suggestions in planning and carrying out certain aspects of the research were made, and unpublished materials were supplied, by Drs. Margaret Hagood and T. Wilson Longmore, Division of Farm Population and Rural Life.

Profs. Paul Homeyer and Emil Jebe of the Department of Statistics gave valuable suggestions on interpretations of statistical data.

The author is grateful to the staff of the Iowa Crop and Livestock Reporting Service for furnishing much unpublished data.

The support of the Iowa Agricultural Experiment Station and of the Bureau of Agricultural Economics, United States Department of Agriculture made this study possible.